Ballistic Missile Defense

Past and Future

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NATIONAL SECURITY POLICY
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WASHINGTON, DC
April 2010

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **APR 2010**	2. REPORT TYPE	3. DATES COVERED **00-00-2010 to 00-00-2010**

4. TITLE AND SUBTITLE **Ballistic Missile Defense. Past and Future**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **National Defense University,Center for Technology and National Security Policy,Washington,DC,20319**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**87**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

This book was published by the Center for Technology and National Security Policy, National Defense University, Fort Lesley J. McNair, Washington, DC. CTNSP publications are available online at http://www.ndu.edu/ctnsp/publications.html.

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Acknowledgments

I wish to thank Hans Binnendijk, the director of the National Defense University's Center for Technology and National Security Policy, for his encouragement and partial funding of this book. Also, my colleagues at the University of Maryland's School of Public Policy's Center for Public Policy and Private Enterprise, William Lucyshyn, Caroline Dawn Pulliam, and Aly Rodriguez for their help with the manuscript.

Introduction

To help put the potential value of a national missile defense system in perspective, consider three scenarios, one modeled on a historical event, the other two hypothetical. First, suppose that the Iraqi invasion of Kuwait occurs 20 years later, which is to say, about now. Saddam Hussein has an arsenal of two or three long-range missiles equipped with biological or nuclear warheads. These weapons are aimed at New York and/or Washington (or even closer targets, such as Tel Aviv or London). He threatens to launch them if the United States attempts to throw him out of Kuwait. In the absence of a missile defense system, what options does the President of the United States have for dislodging Iraq from Kuwait—or preventing occupation of Saudi oilfields?

The second scenario is a real, near-term possibility. Russian command and control over the launch of ICBMs has deteriorated, The Russian leadership continues to fear a U.S. first strike and believes it must keep its ICBMs on high readiness. The President of the United States receives a "hotline" call from the President of Russia saying: "You were right to keep warning us about the possibility of an inadvertent launch of one of our long-range missiles. In fact, this just happened, and the missile is on its way to strike Washington, D.C. You have my sincere apologies about this catastrophic event, and we will certainly do everything we can to make sure that your people understand this was not intentional. But, recognizing that you have no defensive capability, and that this means a catastrophic loss of American lives, we still think it is the wisest course for you not to respond in any equivalent or escalatory fashion, as it will undoubtedly result in an all-out nuclear exchange and the destruction of both of our countries." Faced with the decapitation of the U.S. Government, what options does the President have for defending the Nation?

Now consider what might happen if the government of Pakistan comes to be led by an extremist, anti-U.S. fanatic, perhaps as the result of an election manipulated by pro-Taliban groups, or of massive protests against U.S. operations in Afghanistan and Predator strikes in Pakistan. Pakistan has Scud ballistic missiles, an intermediate range ballistic missile under development (with a range of over 2,000 km), sensitive missile and guidance technology provided by China, and is

believed to have approximately 60 nuclear warheads.[1] In the near future Pakistani nuclear-armed missiles could threaten major cities of nations allied with the United States. Depending on how much outside help Pakistan receives, it could soon threaten the United States. What options are open to the American President as Pakistani armed forces come under the control of leaders who are implacably hostile to the United States?

These three scenarios (others could be constructed around North Korea, Iran, and Syria) make a point argued by proponents of continued exploration and deployment of ballistic missile defense systems: that it is essential to give future Presidents of the United States options for defending the homeland against missile attack. As demonstrated by the attacks on New York and Washington on September 11, 2001, there are those in some parts of the world who are not deterred by the threat of invasion or even nuclear retaliation (including some rulers of so-called rogue states). A national missile defense system could provide a shield from destruction in the event of a threatened or actual launch by a rogue-state leader or a powerful transnational terrorist group, as well as an unintentional launch by Russia or China. (These limited defense systems are not intended to be effective against high-volume and sophisticated attacks from either Russia or China.) It is for this reason that serious consideration and funding is being provided for a limited ballistic missile defense system that could potentially be effective against such increasingly likely events. Needless to say, the degree of international interest in this topic increased significantly after North Korea launched a long-range Taepodong-1 over Japan in 1998.

Today, there is widespread disagreement as to whether such a system *can* be developed to be effective against such eventualities. There is also heated discourse as to whether or not such a system *should* be developed and deployed. These are the two big questions of the anti-ballistic missile (ABM) debate. It must be emphasized that the

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[1] "According to most public estimates, Pakistan has about 60 nuclear weapons, though it could have more; a recent public estimate from two prominent experts on the subject stated that the country has between 70 and 90 nuclear weapons." Paul Kerr and Mary Beth Nikitin, *Pakistan's Nuclear Weapons: Proliferation and Security Issues*, CRS Report for Congress RL 34248, updated December 9, 2009, 3. Available at http://assets.opencrs.com/rpts/RL34248_20091209.pdf.

answer to these two questions is irrelevant with regard to tactical ballistic missiles or cruise missiles. With the widespread proliferation of these tactical offensive weapons, there is multinational agreement on the need for the development and deployment of tactical anti-missile systems. And there have been sufficient successful demonstrations of the technical feasibility of such systems. Thus, the answer to whether these tactical defense systems can and should be implemented is affirmative.

As the range of proliferated offensive missiles continues to expand, the distinction between what is tactical and what is strategic becomes increasingly vague, and, the required range capability of "tactical" anti-missile systems becomes greater and greater. For Europe or Israel, the distinction between tactical and national (i.e., "strategic") missile defense largely disappears. For the United States, the issue of national missile defense remains highly controversial. It is this latter specific issue that this book addresses.

It is my opinion, based on a lifetime of personal involvement in the field,[2] that in answer to the question of whether a national missile defense system could be implemented against the set of hypothesized threats—namely, a small number of unsophisticated missiles launched from a developing country, or a single, inadvertent launch from either Russia or China—the answer is that we *can* develop such a capability, but that the system will not be "perfect." Realistically, no defensive system can be 100 percent effective. However (especially employing multiple defensive launches), it should be adequate to serve the purpose of saving a very significant number of lives in either of the two types of situations, and it could provide an additional defensive option to the President in a future international crisis. As to the second question, "*should* it be done?," I believe that a limited system should be deployed because of its deterrent value and the possibility of saving so many American lives, *but* R&D and testing should be continued to enhance its capability against evolving threats, and deployment should be done in connection with extensive international agreements and controls related to a new, national strategic posture, based on both offense and defense systems, as well as tightened proliferation controls.

Finally, since the 9/11 attacks, many have argued that "because terrorist attacks (of a variety of forms, from traditional to biological and

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[2] See "About the Author" at the end of this book.

even nuclear) are more likely than ballistic missile attacks, we should not waste money on the latter.” I personally believe (and will argue herein) that ballistic missile attacks, while admittedly less likely than terrorist attacks, are nonetheless such a potentially lethal danger, and of a reasonable likelihood, that it is only prudent for nations to provide a deterrence against their use and insurance against the destruction they could cause.

Clearly, the United States has been increasingly exploring anti-terrorism capabilities. In fact, the major share of the $40 billion or so of the Department of Homeland Security’s Budget, plus a major share of the Intelligence Community’s budget, plus a significant share of the DOD budget—involved in the “war on terrorism,” e.g., in Afghanistan—are all focused on anti-terrorism. While the amount being spent on ballistic missile defense is an order of magnitude less (around $11 billion a year) it is well within the affordability range in a DOD annual budget of $500 to $600 billion plus.

Undoubtedly—and necessarily—the anti-terrorism budget will continue to increase, but I do not believe that this is an either/or choice. Both terrorism and ballistic missile threats are of an asymmetric nature, with weaker nations being more likely to use such tactics against the United States and its allies. Since conventional deterrence may not work against some future adversaries (from rogue nations to terrorists, and the likely combination thereof), I believe that continued development and limited deployment of a national ballistic missile defense system is even more warranted today. The horrible acts of September 11, 2001, were committed by people willing to die in order to kill Americans. In the face of such an enemy, traditional deterrence theory is brought into question.

Public opinion in the United States has moved strongly toward support for national missile defense, against the urgings of outspoken opponents. A 2008 poll by Opinion Research Corporation and CNN found that 87 percent of the American public supports creation of the multilayered U.S. ballistic missile defense system, and 65 percent believe the U.S. missile defense system should protect allies as well.

Chapter 1

Overview

Ever since Germany launched the first ballistic missiles against England on September 8, 1944, (one V-2 landing in London and a second one near Epping 16 seconds later), there has been considerable controversy over the desirability of being able to defend a nation against ballistic missile attack. There has been little question of the need to defend troops against such threats, particularly as the accuracy and the destructiveness of missile attacks have increased. If any doubt of the danger to troops remained, it was erased in 1991, when Iraq launched a Scud missile against the U.S. military barracks in Dhahran, Saudi Arabia, at the end of Operation *Desert Storm*, killing 28 U.S. soldiers and wounding 99. However, the issue of national missile defense has been far more controversial. Debate was heated in the United States in the 1960s and early 1970s, as the Soviet Union grew to be an increasing ballistic missile threat, and the United States began to develop a capability for at least some form of national missile defense. In fact, widespread deployment was given very serious consideration (and its initial phases begun) prior to the signing of the anti-ballistic missile treaty in 1972. The debate revived when Ronald Reagan announced his Strategic Defense Initiative (dubbed “Star Wars” by its critics) in 1983. Controversy ignited again with President George W. Bush’s decision to abrogate the treaty and initiate early deployment of the ground-based national missile defense system, along with aggressively accelerating development of air-, sea-, and space-based systems.

Two things stand out in regard to this decades-long debate. First is the extreme polarization of the opposing positions that have been taken. Consider this statement:

> “The whole ABM question touched off so intense and emotional a debate as to be virtually without precedent of any issue of weaponry. Highly-knowledgeable and specifically-informed people could be found on both sides of the argument. Scientists, engineers, and others disagree with each other about

the reliability or basic workability of the system. The amount of obvious bias on each side was often wondrous to behold."[1]

This passage happens to be referring to the 1960s and early 70s, but it could just as easily have been written last week.

At the extreme level, those against development and deployment of such a system argue, with an almost religious fervor, that it won't work; and even if it could, it would start an arms race. Those in favor of national missile defense (again at the extreme) argue that it is irresponsible not to build a system to defend America, and we should deploy it as soon as possible. What is particularly interesting about this debate is that the parties who might be counted on for a more objective and independent perspective, such as the news media and think tanks, are equally biased—not just in their editorials, but in their reporting. For example, Peter Jennings, on ABC's *Worldwide News Tonight*, called missile defense a system "that has never been proven to work and may never work."[2] The *Los Angeles Times* suggested that missile defense would put the country at "greater risk of attack." NBC's Jim Miklaszewski questioned whether such a system is "worth it, in light of its possible threat to United States/Russian Relations." *Newsweek* asserted that, "it's time to Deep-Six this Mega-Billion dollar fiasco." William J. Broad of the *New York Times* and others compare missile defense to failed military defenses of the past, such as the Great Wall of China and the Maginot Line.

Such extreme views have also been reflected in Congressional debates. Senator Howell Heflin[3] stated that, "The ballistic missile defense program has always been turbulent, buffeted more than most defense programs by partisan political debate and contentious strategic theories."[4] He went on to state that, "the 'Weapons in Space' objective was so pervasive and intense that it resembled an evangelical

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[1] Bernard Brodie and Fawn Brodie, *From Cross Bow to H -Bomb* (Bloomington, Indiana, University Press, 1973), 305–306.
[2] Sean Vinck, "The Media War on Star Wars: Where never is heard an Encouraging Word," *Weekly Standard*, July 24, 2000.
[3] Dissertation by Glenn LaMartin, "Political Theories of Public Policy Making: A Test of the Ability of Political Theories to Predict the Features of the Policy Process," University of Southern California, August 1999, 94.
[4] Senator Howell Hefflin, "Reflections on the course of Ballistic Missile Defense Programs" *National Security Studies Quarterly*, Spring 1997.

religion."[5] About the same time, Representative Curt Weldon charged that intelligence information is being heavily politicized to support the Clinton Administration's policy of keeping Americans undefended from missile attacks.[6]

Interest group advocacy is also strongly argued and equally polarized—including groups that were, in theory, independent and objective. Such nonprofit organizations as the Union of Concerned Scientists have issued statements (including those by former Nobel Prize winners) that "showed" why not only would the system not work, but why it was wrong to deploy it. For example, in an article titled "Technical Realities," the Union of Concerned Scientists stated that the system to be deployed in late 2004 "will have no demonstrated capability and will be ineffective against real attack by long-range ballistic missiles," and went on to state that the Bush Administration's "claims that the system will be reliable and highly effective are irresponsible exaggerations." Similarly, John Pike published an article with the title "National Missile Defense: Rushing to Failure."[7] Eight years later, William Hartung published "Anti-Missile Missiles in Europe: A Weapon that Doesn't Work for a Threat that Doesn't Exist."[8] At the extreme, perhaps, after a successful intercept (direct hit) of a target intercontinental ballistic missile, one of their members, Ted Postol of MIT, wrote to the President of the United States stating that I, as Under Secretary of Defense and thus responsible for the ballistic missile defense program, had "fixed" the test so that the interceptor missile (launched from the Marshall Islands, out over the Pacific) would "home on a signal from the target." (An allegation that had no factual basis whatsoever.)

Another extreme position was that taken by the Director of "Project Abolition," who maintained that mutual assured destruction (MAD) is

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[5] Ibid.

[6] "Ballistic Missile Defense: Responding to the Current Ballistic Missile Threat," Hearing before the Subcommittee of National Security, International Affairs and Criminal Justice of the Committee on Government Reform and Oversight, May 30, 1996.

[7] John Pike, "National Missile Defense: Rushing to Failure," *Journal of the Federation of American Scientists*, 52, no. 6, November-December 1999.

[8] William Hartung, "Anti-Missile Missiles in Europe: A Weapon that Doesn't Work for a Threat that Doesn't Exist," April 26, 2007, available at http://www.worldpolicy.org/projects/arms/updates/042607.html#1.

"morally indefensible," and that the only realistic, sustainable, affordable solution to the moral and security problems posed by nuclear weapons "is their complete elimination."[9]

These attacks on the U.S. missile defense system greatly weaken its deterrent effect—in terms of discouraging adversaries not only from using ballistic missiles, but also acquiring and proliferating them—as well as cause allies to question our ability to defend them, with the perverse effect of motivating them to develop their own nuclear offensive deterrent forces. Certainly, claims about the system's effectiveness must have credibility. But, if valid, the availability of these system effectiveness facts is critically important to the future security of the United States and its allies. Thus, steps must be taken to assure allies and adversaries of the effectiveness of the system (by not hiding behind security classification; by allowing observers at tests; by joint developments and operations; etc.).

Contrary positions (in support of development) are held just as strongly by such organizations as the Institute for Foreign Policy Analysis, and the Center for Security Policy, which argue that it is immoral not to have a ballistic missile defense system to protect American citizens. The public is similarly split, often along Republican ("conservative") and Democratic ("liberal") perspectives. However, a 2001 poll by the Council on Foreign Relations[10] reported that 51 percent of Americans favored the deployment of a national anti-missile defense system and only 38 percent opposed it. Of self-described liberals, 45 percent favored building it (as compared to the 70 percent of the self-described conservatives who favored it). Another poll earlier that same year by the Washington Post and ABC News[11] reported that 80 percent of the American population was in favor of building a missile defense system; however, they posed many reasonable questions about it: Will it work? Will it be affordable? Will it lead to an arms race? And will Europe pay for their share? Thus, the population

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[9] Kevin Martin, Director, Project Abolition, Goshen, Indiana, *Washington Post*, July 26, 2001.
[10] Paul Richter, "Majority in U.S. Backs Missile Shield, Poll Finds," Los Angeles Times, June 12, 2001.
[11] ABC News/The Washington Post January 2001 [Computer file]. ICPSR version. Horsham, PA: Taylor Nelson, Sofres Intersearch [producer], 2001. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2001. doi:10.3886/ICPSR03193.

wants "protection," but it is clearly aware of some of the issues that have been raised, and they want answers. And, as the data in the "Introduction" noted, public opinion has clearly been shifting in favor of the system (with, by 2008, 87 percent in favor). If nothing else, at least all of the emotional discussions following the North Korean launch of a missile over Japan in 1998 served to make the public much more aware of the issues associated with national missile defense. Prior to that event, the public either had very little interest in the topic or was uninformed on the issues. In fact, a January 1995 poll showed that 57 percent of the American population believed that the military could destroy a missile fired at the United States before it could hit and do damage.[12]

Today, there are still questions as to whether the "facts" presented to the public validly reflect both sides of the issue, or are even correct. This is a terrible shame. If the system can be shown to be effective, and the data are made public, it can have a very significant impact on the missile defense system achieving its intended objectives (and of convincing the U.S. public, the Congress, and U.S. allies and friends—as well as potential adversaries—of its value). Specifically, these objectives include:

- Limiting damage (to lives and property, if attacked)
- Deterring adversary use (since their objective will likely not be achieved, and they now will face retaliation)
- Giving the President options (besides preemption or total counterattack)
- Aiding achievement of arms control agreements (by overcoming risk of non-compliance or breakouts)
- Providing assurance to allies and friends (of our support, since we are less vulnerable to threats to attack us, if we come to their defense)
- Discouraging proliferation of ballistic missiles (since buyers have less incentive if the purchased missiles are not effective)

The second thing (besides the extreme polarization and emotional fervor) that stands out about the sets of debates that have taken place on

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[12] Dissertation by Glenn LaMartin, "Political Theories of Public Policy Making: A Test of the Ability of Political Theories to Predict the Features of the Policy Process," University of Southern California, August 1999, 227.

National Missile Defense—first in the 1960s and early 1970s, again in the late 1980s and 1990s, and continuing today—is that they exhibit a great deal of consistency over time, despite obvious differences in technology, threats, and system approaches. Specifically, the ABM systems being considered in the 1960s were aimed at either the reentry or the immediately preceding exoatmospheric phase of the trajectory of an ICBM warhead coming at the United States; and the kill mechanism was an interceptor missile with a nuclear warhead. In contrast, the system being debated in the 1990s was intended to intercept outside the atmosphere (during the midcourse of an ICBM attack on the United States), and the kill mechanism was kinetic impact (sometimes called "hit-to-kill"). Of course, as described below, numerous other combinations of defense systems have been considered over the years, from interceptors launched from space, to airborne, high-energy lasers for boost-phase kills.

Finally, the threat being addressed in the 1960s was from the Soviet Union, while the focus since 1991 has been on a more limited and less sophisticated threat from a "rogue" nation, such as North Korea or Iran, and a potential inadvertent launch from Russia or China. Despite these differences, the arguments on both sides of the missile defense issue are still almost identical.

The arguments against the deployment of an anti-missile system tend to fall in the following categories:

- *It will trigger an arms race*. Russia will not only move toward increased offensive capability, and perhaps also defensive capability, but will certainly break all arms control agreements with the United States. China will dramatically expand its nuclear arsenal, which would then accelerate nuclear weapons programs in India and in India's rival, Pakistan; and possibly prompt their development and deployment in Taiwan and in Japan (both of whom are concerned about China's expanding power). It might also jeopardize any Chinese diplomatic efforts to achieve a freeze on North Korea's or Iran's nuclear and missile programs.[13]
- *Putting defensive weapons in space* (which would provide worldwide boost-phase intercept coverage) *would start both an offensive and defensive arms race* (including anti-satellite

[13] Senator Joseph Biden, "Senator Biden Attacks Missile Defense Plans as Costly, Risky," *Washington Post*, September 11, 2000.

systems). Also, a space-based anti-missile system would appear to be aimed at the Chinese (as a way to cover their large land mass) and would be highly inflammatory.

- *Deployment of the NMD system would damage the diplomatic relations that the United States has been trying to improve with both Russia and China*. Missile defenses will undercut arms control negotiations. Arms control has historically been the key to maintaining a peaceful relationship between the two "Super Powers," and has been especially important to slowing the build-up of ballistic missiles, nuclear weapons, and other weapons of mass destruction.

- *Even a limited missile defense will create greater instability*. The defended nation will be tempted to initiate a massive first strike in a crisis (including against its adversary's missiles), and then absorb the more limited retaliatory strike by the other side (a product of being able to shoot down surviving ICBMs).

- *The technology is not available to achieve the hit-to-kill capability* (i.e., "the systems won't work"), *and a nuclear kill mechanism* (as planned in the 1960s systems) *would have numerous problems,* both offensively and defensively.

- Even if the system can be made to work against a single target, *the opposition will shift to complex countermeasures*, such as sophisticated decoys, maneuvering reentry vehicles, saturation with multiple re-entry vehicles, etc., *and render the deployed system ineffective*.

- *The deployment of this system, even if it does work, will simply shift the focus of potential adversaries to other means of attacking the United States.* These alternative scenarios are already considered to be "more likely," and include terrorist attacks with biological, chemical, or nuclear weapons.

- *No government would be foolish enough to try to launch a missile against the United States, knowing that its nation would be immediately wiped out with a nuclear counter-strike.* Therefore, no real threat exists, and it does not make sense to develop and deploy a national missile defense system.

- And, even if it does work, and even if it makes sense to develop and deploy it, *the system is far too expensive to be affordable.*

Certainly, this is a very strong set of arguments. Each has an element of truth in it, and each must be addressed.

Equally strong arguments are made by advocates for development and deployment of NMD:

- As provided in the Constitution, *it is the government's responsibility to "provide for the common defense."* Without a deployed anti-missile system the Nation is defenseless against any missile attack on the United States. Even one nuclear weapon impacting an American urban area would cause hundreds of thousands—if not millions—of deaths. There is no question that a defense system should be implemented if it can be done with any reasonable confidence.
- In fact, *it need not be 100 percent perfect, since it will still present a credible deterrent and likely would save many lives*. Additionally, it will be possible to have multiple shots at the target if the system is properly designed, which increases the probability of both destroying the incoming warhead and saving lives. The odds of success are high enough to warrant implementation of a missile defense system.
- *Americans clearly feel "unprotected,"* and that's why the majority of the people want to deploy a system today, if it can be made reasonably effective.
- *The threat is real*. Numerous nations have, or will shortly have, the capability to attack cities in both the United States and allied nations, and many of those countries have declared open hostility to the United States—including North Korea and Iran. Iraq's use of Scud missiles against Tel Aviv (despite Israel's capability to retaliate with nuclear weapons) indicates that these countries would be willing to use their missiles against the United States, even if faced with nuclear retaliation.
- *The United States needs a missile defense system to deter rogue countries from trying to keep the United States out of regional conflicts in which we should be involved*. They can achieve this simply by threatening us, knowing that we have no defense against their threats. The President must have the flexibility to exercise various options, and a defense system provides that flexibility.

- *The presence of a missile defense system will reduce the current, extensive proliferation of ballistic missiles* by reducing the value of offensive weapons.
- *The United States should be protected against the accidental launch of a missile from Russia or China*, rather than being forced either to accept the destruction of a U.S. city or retaliating to destroy one or more cities in either Russia or China. Such a situation would likely escalate into the nuclear annihilation of both the United States and either Russia or China.
- *The development and deployment of such a system,* which might cost around $10 billion per year*, is certainly affordable,* within a $500 to $600 billion-plus annual defense budget. It is simply a question of priorities, and the protection of the American public is a very high priority.
- It is believed that *Russia (and, later, China) would agree to modifications to the Anti-Ballistic Missile Treaty* (thus preserving the overall treaty regimes for strategic systems), since they would recognize that the limited and relatively cruder defense systems being proposed would have essentially no capability against their higher numbers and/or more sophisticated capabilities.
- *It is technically feasible* (as it has been, and will be further demonstrated to be) to build an effective defensive system against the threats currently expected from rogue nations.
- *It is possible to make a safe transition* from reliance on "assured mutual destruction" to dependence upon strategic defense; since we would have the cooperation of Russia (and, later, China) in this transition.
- *Russia already deploys a defense system around Moscow*, and presumably understands the need for the United States to have a credible defense system. However, our limited defense system must be one that is not aimed at eliminating the benefits of the ABM Treaty and its stabilization benefits for the United States and Russia (and potentially, for China).

Again, there is much truth in each of these arguments. Taken together they constitute a formidable case for the development and deployment of a limited defense system. Certainly, they also support continuing R&D, as well as added testing, to thoroughly demonstrate

an effective capability against the potential threat from a rogue nation or an inadvertent Russian or Chinese launch.

The extremely emotional and bifurcated argument for and against national missile defense has been going on for most of the past 50-plus years, as will be demonstrated by the following discussion of the history of anti-missile programs and the enduring issues concerning their deployments. The only possible exception is the period from 1972 to 1983, when the strategic posture of both the Soviet Union and the United States was total reliance on the deterrence of mutual assured destruction.

Naturally, these pro and con arguments will have varying degrees of sophistication and subtlety as one begins to address the specifics of the numerous types of systems that have been, or are now, under consideration. In order to both understand the options for the future, we need to briefly consider the various types of ballistic missile defense systems (and their many elements) and look at the history of the field.

Chapter 2

Types of Ballistic Missile Defense Systems

There are four ways in which a ballistic missile defense system can be categorized: 1) the phase of the offensive missile trajectory in which it is attempting the intercept; 2) the location of the interceptor (land, sea, air, or space); 3) the kill mechanism utilized by the interceptor; and 4) the types and location of the sensors used to track and intercept the target. Let us briefly describe each of these, and their advantages and disadvantages, recognizing that any system is likely to be a combination of some or all of these.

Target Trajectory Phase Categories

A ballistic missile can be categorized by four phases. First, it has a *pre-launch phase*, during which the missile is on the ground, in a ship, buried in a silo, or on a mobile vehicle. In this phase, the missile is highly vulnerable to a preemptive strike. However, both mobile (especially submarine-launched) and hardened (silo-based) missiles are difficult to kill prior to launch and, therefore, represent a "second strike" capability.

Second, when the missile is launched it is initially in its *boost phase*, in which large rockets are lifting the warhead on its way. Since they are burning, they have a very large heat and light signature, so the target can easily be seen and tracked. It is highly vulnerable, as it is large and "soft," and moves relatively slowly as it accelerates up to full speed. This powered flight phase lasts from 200 to 300 seconds. Because of this short duration, any attempt to kill the target in the boost phase requires that the interceptor be very nearby and very fast. Additionally, since the launch happens without much warning, there is very little time for deciding whether this target is an ICBM heading toward the United States or an ally, or is a non-threatening launch of a communication satellite or other space launch; thus, sensors for determining this are clearly required. Surely, there is no time in this phase for a coordinated decisionmaking process, either among agencies or, especially, among nations. The response must be instantaneous.

A major advantage of attempting to eliminate the target during this phase is that it difficult to develop offensive countermeasures, such as a decoy to lure the kill mechanism away from the target. However, more sophisticated techniques are certainly possible; including more rapidly burning rockets and the use of multiple rockets. Finally, it is important to consider that Iran or North Korea would utilize a minimum-energy ballistic attack path in which their missiles would fly over the North Pole (known as “great circle routes”). In doing so, they are flying over territories such as Russia and China (not over water); thus, if we were to have ground-based interceptors in a position to kill the targets during their boost phase, this would have to be done on a cooperative basis with those countries on the flight path.

On a related note, because of the very large size of both Russia and China, there is no way that any ground-based, boost-phase system could be used against either of these countries. This is one of the main arguments often used to urge the development of a ground-based boost-phase system (to be used against “rogue nations”), since it is clearly not a threat to China or Russia. However, a space-based boost-phase intercept system would be capable of covering Russia and China, so it could not be argued that it was limited only to rogue nations.

Third, after the rocket burns out, the warhead goes through an extended exoatmospheric mid-course phase in which it is simply following a ballistic trajectory—unless it intentionally performs maneuvers. (From North Africa, the Middle East or Asia, an intercontinental missile would have to travel 3,000 to 6,000 miles to reach the continental United States; Alaska and Hawaii are closer to Asia.) This mid-course phase (lasting up to 20 minutes) is the one that is most attractive for interception of a warhead, because it is in “free-fall,” allowing for long time periods of analysis and human decisionmaking prior to committing to an intercept. However, this is the phase in which it is most easy to use a decoy to simulate the reentry (warhead) vehicle. This is because, absent atmospheric resistance, objects such as balloons, aluminum chaff, and other lightweight objects have the same trajectory characteristics as a heavy reentry vehicle. That makes this phase of the flight the most difficult for discrimination between the warhead and the many decoys that could be released. Obviously, the more sophisticated the decoying capability that a country has for its ICBM’s, the more challenging a mid-course phase intercept becomes.

Finally, the large “cloud” of decoys and the reentry vehicle (or vehicles) will reach the atmosphere near the target area. For the last 60 to 90 seconds of the flight—the “terminal,” or “reentry” phase—these objects are “sorted out” by the atmosphere; the dense, pointed reentry vehicle will move rapidly through the atmosphere, while the lighter objects will slow down. From a discrimination perspective, the use of the atmosphere is very attractive, but from a timing perspective, it is extremely challenging to wait for the sorting to take place and then commit interceptors to kill the reentry vehicle, prior to its rapid approach toward its target.

As can be seen, each of these phases has significant advantages and disadvantages relative to an anti-ballistic missile system. As history has shown, each option will have its advocates and critics; and known problems have been and/or are currently under consideration for solutions.

Interceptor Location Categories

The most obvious place initially considered for a missile defense system is in the vicinity of the defended area. Thus, *ground-based systems* located near the target form the first approach to interception. This certainly would be the first choice for the defense of troops, command centers, and even population centers, and it is currently the approach for theater (tactical) systems. It is the basis of several defense systems, including: the Russian system around Moscow; the Army’s Patriot (PAC-3) system (figure 1), which was used in the Persian Gulf conflict against Iraqi Scud missiles; the Army’s longer-range THAAD system (figure 2);[1] and—although not located in the primary target area—the limited National Missile Defense system (figure 3) that is being deployed, initially with 20 interceptors, divided between Fort Greely, Alaska, and Vandenberg Air Force Base, California, for protection against rogue nation launches against the United States

[1] Available at http://www.mda.mil/news/gallery_thaad.html; accessed on September 17, 2009.

Figure 1. The Ballistic Missile Defense Organization and the U.S. Army conducted a successful test of the Patriot Advanced Capability-3 (PAC03) missile at White Sands Missile Range, N.M., February 5, 2000. The PAC-3 missile is a high velocity, hit-to-kill missile and is the next generation PATRIOT missile being developed to provide increased defense capability against advanced tactical ballistic missiles, cruise missiles, and hostile aircraft. The PAC-3 missile uses kinetic energy (i.e. "hit-to-kill" to destroy targets rather than employing a high explosive warhead. It is the basis of the U.S./German/Italian, and now NATO, theater missile defense system (known as MEADS).

Figure 2. On March 17, 2009, the Terminal High Altitude Area Defense (THAAD) missile defense element completed a successful intercept of a ballistic missile target at the Pacific Missile Range Facility off the island of Kauai in Hawaii. THAAD is a mobile system designed to intercept short to medium range ballistic missiles. Soldiers of the 6th Air Defense Artillery Brigade conducted launcher, fire control, and radar operations using tactics, techniques, and procedures developed by the U.S. Army Air Defense School.

Figure 3. A Ground-Based Interceptor is shown shortly after liftoff from a silo at Vandenberg Air Force Base, California, on December 5, 2008. The launch, designated FTG-05, was a test of the Ground-based Midcourse Defense element of the National Missile Defense System. The missile successfully intercepted and vaporized a long-range target launched from Kodiak, Alaska, several minutes earlier (see figure 4).

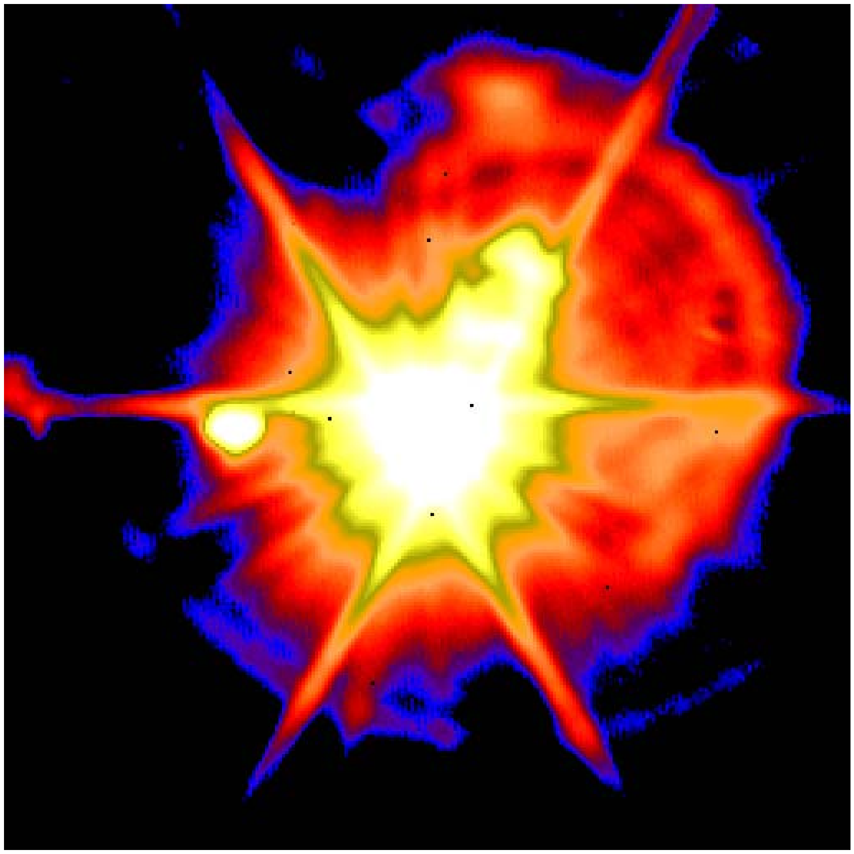

Figure 4. Infrared imagery of December 5, 2008, National Missile Defense System target kill of an ICBM re-entry vehicle over the Pacific.

Figure 5. An Arrow anti-ballistic missile is launched July 29, 2004, as part of the ongoing U.S./Israel Arrow System Improvement Program. The missile intercepted a short-range ballistic missile target west of San Nicolas Island on the Point Mugu Sea Range in California. This was the twelfth Arrow intercept test and the seventh test of the complete Arrow system.

A ground-based system is also the chosen basing mode for Israel's Arrow system (figure 5), which is particularly focused on Iran's missile launches; for the U.S./German/Italian, and now NATO, troop-protection system (known as MEADS); and for the French/Italian SAMP/T (tactical) system.

The second area for interceptor location consideration is that of a *sea-based system*. Naturally, this is immediately considered for defense of the fleet, but its use has also been considered for boost-phase intercepts against missiles that are launched close to water and/or fly over water (for example, a launch from North Korea targeting Hawaii). The sea-based system could be used against any of the phases of an ICBM: if close by, it could be used during the boost phase; if the target is flying overhead, it could be used in the mid-course phases; it could even be located near an urban area or in a harbor, and used in the terminal phases.

Figure 6. AEGIS Cruiser Launch of Standard Missile-2 Block IV.

However, modern day interceptor use in the boost phase would require the development of a new, high-speed interceptor. (Because it is trying to catch up with the booster, it would probably have to have acceleration capability in the range of 30Gs and speed in the range of 8 kilometers/per second at burnout.) Also, it would certainly have to address the question of ship vulnerability, either from submarine launched torpedoes and/or ground-launched cruise or ballistic missiles aimed at the ships themselves. It could only be used for those limited cases in which the geometry was favorable to a ship-based system. Finally, a sea-based boost intercept may require new, special-purpose ships, which would drive the cost of this approach up significantly. Nonetheless, the United States currently has a very effective, ship-based tactical anti-missile system—the Standard Missile-2 (SM-2) (figure 6)—and has even used it for a successful anti-satellite kill, so this option cannot be quickly dismissed. And, for this reason, further development of the Standard Missile (SM-3) is continuing. In fact, this is a particularly attractive option for an island defense system (especially against mid-range missile systems), so it is attractive for and Taiwan.

In a joint missile defense intercept test with the Missile Defense Agency to intercept a medium-range, a Japanese DDG launched an SM-3 to intercept a separating target that had been launched minutes earlier from the Pacific Missile Range Facility, Barking Sands, Kauai, Hawaii (see figure 7). The ship's crew detected and tracked the target, and its weapons system developed a fire-control solution and then launched the SM-3.

Figure 7. An SM-3 is launched in mid-Pacific from the Japanese Ship (JS) CHOKAI (DDG 176. (Photo courtesy of MDA.)

Another possibility is an *air-launched system*, whereby flying the interceptor close to a missile launch site could gain some advantages, and—if ready for the launch and with a high-speed interceptor—perhaps achieve a boost-phase kill. But the mission places the aircraft in a vulnerable area and requires it to be airborne for long periods of

time, waiting for the offensive missile launch. An attractive option for the airborne system is the use of a high-energy laser aboard the aircraft, so that it does not have to have to carry many interceptors and can achieve a high-speed kill (literally, at the speed of light) by heating the “soft” and explosive booster (see below).

Finally, the system can be *spaced-based*. This was the initial concept of Ronald Reagan’s Strategic Defense Initiative. In this case, a large number of low-altitude satellites, containing either interceptors, or high-energy lasers, or neutral-particle beams, would be continuously orbiting the earth. These satellites could attempt to shoot down any launches in either the boost or mid-course phases. This is likely to be the most expensive of all the systems, and it is the only one of the various systems under consideration that is equally applicable to Russia and China, as well as to rogue states. For this reason, it is of most concern to those who would like to maintain a stable strategic posture based on offensive *and* defensive systems; but could be achieved with agreement from Russia and China as to its mutual desirability (a topic that will be addressed later). There is also a very real concern that the implementation of a space-based system might be considered destabilizing because during deployment of the system there is a period of potential first-strike vulnerability that a U.S. adversary might attempt to exploit. This is especially true when one takes into account the fact that after deployment a successful first strike would be impossible—assuming the space-based system was sufficiently robust to handle large attacks. In spite of the high cost, technical questions, and political issues associated with space-based lasers, there has been periodic pressure to, at the minimum, conduct the research and demonstration of such capability (see below).

Kill Mechanism Categories

Because of the difficulty of “hitting a bullet with a bullet,” and because of the discrimination difficulties associated with finding the warhead in a group of decoys, the first kill mechanism considered was a *nuclear warhead* on the interceptor vehicle. This is the approach that was used by both the Russian system and the early U.S. programs. It has obvious disadvantages in terms of nuclear fallout in the defended area and the electromagnetic pulse (EMP) impacts on the defensive system (for example, by blanking out the radars).

The traditional mechanism for shooting down airplanes has been *kinetic kill*, whereby the interceptor directly hits the target and totally destroys it. This is referred to as “hit-to-kill” (in the anti-missile case) because of the very high closing velocity between the target and the interceptor (15,000 miles per hour). In the case of antiaircraft missiles, the interceptor uses a high explosive and/or a heavy metal expanding warhead to kill the target from a few feet away. It does this by utilizing a fusing device that sets the warhead off at the precise time required. For many years it was thought that the extremely high speed of an intercontinental ballistic missile and the very high speed required for the interceptor to get to the target would result in such a high closing velocity between the two that would make it almost impossible to cover the closing distance with high accuracy. However, two U.S. anti-missile flights in 2001 successfully demonstrated that direct hits can be achieved when the interceptor is initially guided from the ground to the proximity of the oncoming target warhead. It can then use its own discrimination and homing capability maneuvers to be at the right spot for a direct intercept. (See figure 8 for location of interceptor on front of booster vehicle. See figure 9 for the interceptor vehicle; sensor on top, control thrusters on bottom).

One of the reasons that kinetic kill is so attractive is that the direct impact of two warheads will completely vaporize the threatening warhead (as was shown in figure 4), which is obviously highly desirable if the reentry vehicle contains a biological or nuclear warhead.

Figure 8. Exoatmospheric kill vehicle (EKV) interceptor on launch pad.

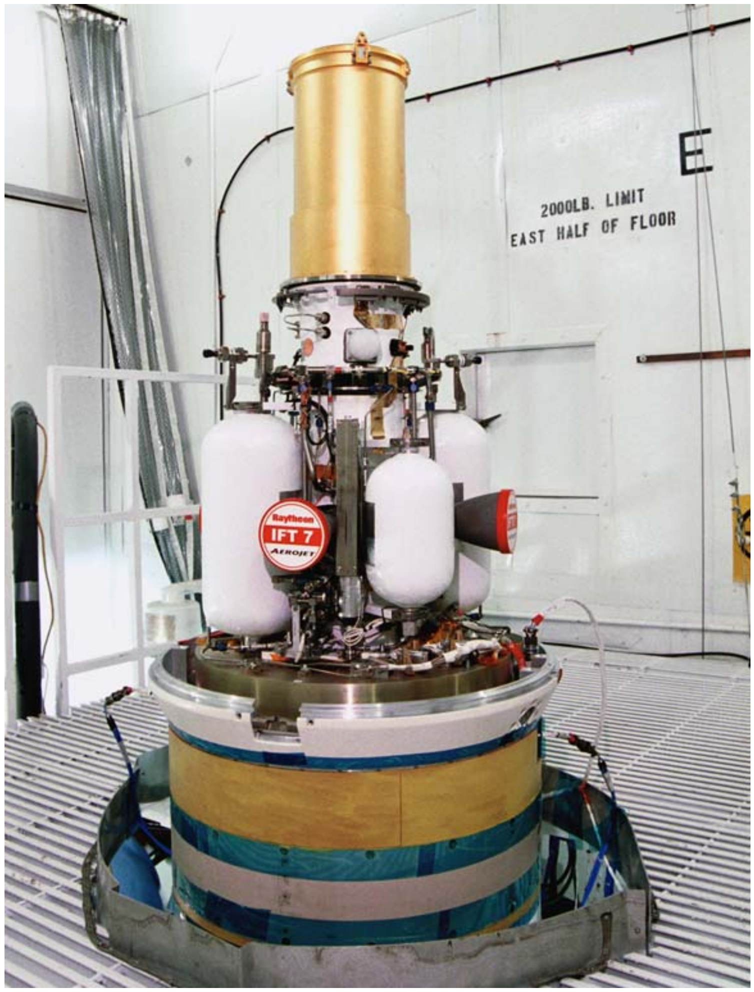

Figure 9. The Missile Defense Agency achieved a successful intercept of a ballistic missile target on March 15, 2002. The test successfully demonstrated exoatmospheric kill vehicle (EKV) flight performance and "hit-to-kill" technology to intercept and destroy a long-range ballistic missile target.

The last of the kill mechanisms under consideration is a *high-energy laser*. Until relatively recently, this was not considered a state-of-the-art approach; however, major developments have led to the feasibility of this option. In 2000, a joint U.S.-Israeli ground-based laser system was used to shoot down Katyusha rockets.[2] This geometry is particularly challenging, because of the difficulty of pointing, tracking, and continuous lasing, as the laser beams go through the low altitude atmosphere. The Air Force's Boeing 747-based airborne laser system (see figures 10 and 11) has the advantage of operating at higher altitudes, where the atmosphere is thinner and there are fewer disturbances.

Figure 10. YAL-1 Airborne Laser (ABL) is a heavily modified Boeing 747-400F fitted with a megawatt-class chemical oxygen iodine laser (COIL). Prior to termination of the program, the Air Force envisioned a fleet of seven aircraft.

[2] These flights took place in 2000, and the destruction was done by the tactical high-energy laser (THEL) at White Sands, New Mexico.

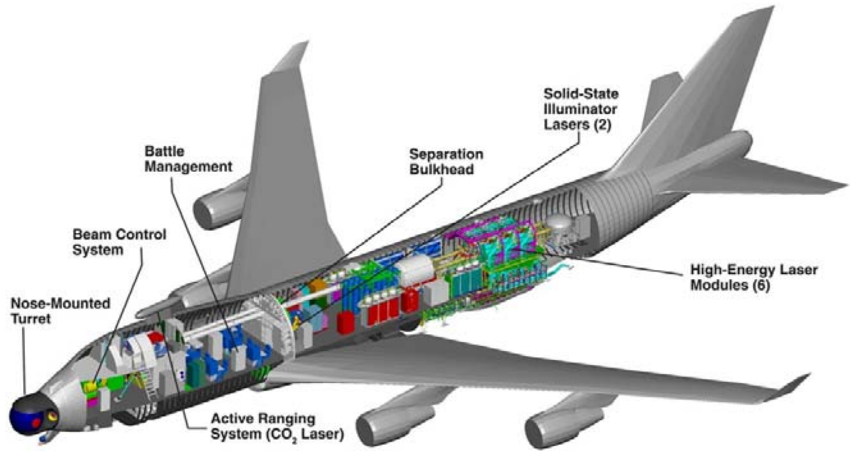

Figure 11. Cutaway view of YAL-1.

With the high-energy laser, the kill mechanism is the heating of the booster rocket case, causing the rocket to explode prior to releasing the reentry vehicle. If this happens late in the powered flight, the reentry vehicle can still continue on some path, and might hit an alternate target. Therefore, an early kill is highly desirable. Also, there are counter-measures that could be used against a laser kill, such as reflective paint on the booster, or spinning the booster so that the heat can be disbursed. Nonetheless, as discussed below, there have been significant investments made on airborne lasers in the 60s, then again in the 70s, and again in the 90s. And, on February 11, 2010, the airborne laser successfully shot down a ballistic missile two minutes after it was launched.[3] (However, for operational, technical, and cost considerations, Secretary of Defense Gates terminated the further procurement of the airborne laser program.) The potential for using lasers in space is also attractive because of the lack of atmosphere. Additionally, since a multi-satellite, space-based system covers the whole earth at all times, it overcomes the severe operational problem of an aircraft-based system of having to be always airborne in the area of the target launch (since there is the possibility of a launch, without warning, almost all of the time). However, the space-based laser does present significant problems, in terms of technology and cost. As noted

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[3] "Airborne laser shoots down missile in mid-flight," Chris Gaylord, The Christian Science Monitor, February 12, 2010.

above, it also has important considerations for arms control agreements with Russia and China.

Types and Locations of Sensors

Any ballistic missile defense capability is likely to combine a number of sensors. First, sensors must warn the defense system that a missile has been launched; then, they must track and establish the missile's path; next, they must be able to discriminate between the warhead (or warheads) and the cloud of decoys, and then guide the interceptor to the warhead, and kill it. Finally, it would be desirable to be able to determine whether an intercept was successful (in order to be able to do a ripple-fire, i.e. based on a "shoot-look-shoot" strategy). Since a lot of these sensors may be distributed in different locations, and many of the defensive systems will want to have a "man in the loop" decision process, before shooting down a target, *there is a need for a very complex, secure, and reliable command, control, and communication system for any of the systems proposed*.

The types of sensors involved in most of these systems would include:

Warning Systems. **S**pace-based, missile-launch-warning satellites have been deployed by both the United States and Russia for many years. Located in a geo-synchronous orbit, they utilize their heat-sensing (infrared) detectors to look for launches of missiles anywhere in the world. In most cases, the sensed launches have been missile tests that were or were not previously announced; these instances can be used for testing the sensor systems. The United States has committed to an upgraded version of these sensors (known as the "Space-Based Infrared System—High," or "SBIRS-High"), which will be more sensitive and capable of establishing the post-launch target tracks (and, therefore, launch intent) more accurately than prior systems. An area of great concern is the deterioration of the Russian sensor system, which could incorrectly indicate a U.S. missile launch and result in a Russian "launch-on-warning" of a massive nuclear strike against the United States. For this reason, the United States has offered to share its warning data with Russia.

Tracking and Evaluation Systems. These can be ground-based radars that are forward located (such as in Greenland, on the Aleutian Islands (Shemya), in England (Fylingsdale), in Central Europe, and on Cape Cod, or even sea-based (see figure 12.)

Figure 12. The Sea-Based X-Band radar arrives in Pearl Harbor, Hawaii, aboard the heavy lift vessel *Blue Marlin* on January 9, 2006.

Additionally, the United States has explored large (over 500 feet long), ultra-long-endurance (30 days), high altitude (65,000 feet), lighter-than-air airships to carry sensors aloft.[4] The sensors can take (or generate) warning data (i.e. target detection), and then begin the process of tracking and discrimination among objects in space. For

[4] Robert Wall, "Surging Aloft," *Aviation Week and Space Technology*, October 6, 2003, 52.

precision tracking and discrimination, an “X-band” radar with the capability to distinguish a golf ball at a distance of 2,400 miles (the distance from Washington, DC, to Seattle, Washington) would be utilized.[5] With detailed computer processing of the target signals received back from such a radar, many of the characteristics of size, tumbling, etc. associated with warheads and decoys can be determined. Additionally, a space-based infrared tracking system operating in low-earth orbits can do additional mid-course discrimination amongst the various bodies, based on characteristics such as heat. (The United States intends to deploy about 20 of these low-altitude, space-based infrared systems, known as “SBIRS-Low,” with infrared sensors for mid-course discrimination.) Finally, the X-band tracking radars can be located near the target area for terminal phase tracking and discrimination. In addition, these forward-based and/or terminal phase radars can be used for the target-kill evaluation (to assess the need for additional interceptor launches).

Homing Sensors. Lastly, the interceptor itself should contain sensors so that it can do the final guidance and control maneuvers required to achieve a direct hit on the target. This can either be a small radar or, more likely, an infrared and/or optical system, in order to first perform the final discrimination among objects near the warhead, and then to assure that the interceptor is hitting the precise place on the reentry vehicle to achieve maximum damage.

It is the combination and, particularly, the integration of multiple sensors, discriminating on multiple criteria, that allows some degree of confidence in being able to discriminate between warhead and decoys (which are intentionally made to appear, in various forms, as threats).

The Missile Defense Agency and the U.S. Navy launched a prototype Standard Missile-2 Bloc IVA from the “Desert Ship” complex at White Sands Missile Range, NM, on January 25, 2002. A hit-to-kill intercept occurred. An example of the seeker imagery from that test is presented in figure 13.

[5] Statement of Lieutenant General Ronald T. Kadish, USAF Director, Ballistic Missile Defense Organization, before the House Subcommittee on National Security, Veterans Affairs, and International Relations Committee on Government Reform, September 8, 2000.

Figure 13. Infrared interceptor seeker image of target.

Overall System

From the description of the various elements of a ballistic missile defense system, the extreme complexity of the overall system becomes obvious. This is further compounded by the fact that the ultimate configuration will be a “layered” system—combining many of the boost, midcourse and terminal elements, and the individual full systems—making it not only a difficult technical and budgeting challenge, but a multi-Service, and even multi-national organizational challenge. In addition, as the threat and the technologies change, the overall system must continue to evolve. In fact, the NMD system acquisition approach is to utilize “Spiral Development,” with a new “block” coming on line every two years. For example, as adversaries utilize multiple re-entry vehicles and decoys on a single ICBM, the

United States has been considering “multiple kill vehicles” (more than a dozen) launched on a single interceptor.

Overall, perhaps the biggest challenge for the integrated, ballistic missile defense system is the Command and Control system; particularly when other nations are involved. Even a long-range shot (e.g., one from North Korea to the Western United States) is still only 25–30 minutes—and less to Europe. So, in this time, the target must be detected, its path established (to determine if it is a threat), then a launch decision made (and coordinated, if multi-national), the battle management worked out (e.g. multiple interceptors lunched, or shoot-look-shoot), then evaluation of kill and decision on further actions. Naturally, all of this will have to be done with computers (but with a “man in the loop”). The software and communication challenges for this system are massive—linking (in real time) the many distributed sensors, the command and control systems, the interceptors and their guidance systems, etc. It is estimated that the software for this system will require more than 1.2 million lines of code.[6] Thus, it comes as no surprise that ballistic missile defense is one of the most challenging of defense weapon systems. Yet *the results to date prove it can be done*. But the questions still remain: how effectively, and at what cost?

[6] “Missile Defense: Software Integration,” *Aviation Week and Space Technology*, June 28, 2004, 50.

Chapter 3

Countermeasures

As the above discussion makes clear, and as will be examined in even more detail by the following history discussion, the concept of simply hitting a target during the various phases of flight, with an interceptor, has now largely been (or could easily be) successfully demonstrated. There are of course operational problems associated with the boost-phase intercept and the terminal-phase intercept, and there are significant problems associated with the discrimination problem in the mid-course phase (especially if more than just the reentry vehicle and the boost vehicle are present). The degree of difficulty of this discrimination challenge is a function of the sophistication of the threat.

Since the earliest days of ballistic missile defense research, the United States has also had research underway associated with counter-measures that it could use in penetrating Soviet defense systems. Because the latter was based on a largely terminal-phase intercept, the U.S. counter measures program was focused on that area (under an effort being performed by the Defense Advanced Projects Agency and the U.S. Air Force, known as the ABRES Program, which stood for Advance Ballistic Reentry Systems). Here, areas such as maneuvering reentry vehicles; multiple reentry vehicles; many forms of passive decoys; passive penetration aides (e.g. “darts” and “jacks”); and electronic-warfare penetration aides were all investigated. This was funded during the 1960s and early 70s, at a level of $300 to $400 million per year;[1] and covered research and development as well as production of U.S. countermeasures. (In current dollars this would be about $2 billion per year.) It is extremely important to highlight the fact that more sophisticated counter-measures, such as maneuvering reentry vehicles, fast-burn boosters, sophisticated decoys, electronic counter-measures, impact fusing of nuclear weapons, precursor nuclear explosives or even anti-satellite weapons, are not believed to be available to third world countries[2] in the foreseeable future, but could certainly be available to countries such as Russia and China; and to others in the longer-range.

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[1] “Counter Measures,” Union of Concerned Scientist, April 2000, 145.

[2] Charles Glasser and Steve Fetter, “National Missile Defense and the Future of US Nuclear Weapons’ Policy,” International Security, 2001.

The "game" of countermeasures and counter-countermeasures goes on in every aspect of military operations, as is the case here. The offense always has a distinct advantage, as it can decide what it wants to do; the defense must guess what the offense will do and develop counters to anticipated attacks. One of the ways in which the defense can try to overcome their inherent disadvantage is by taking a wide variety of approaches. This is the logic behind the current U.S. strategy of developing a "layered defense," which would have some aspects of intercepting a missile in multiple phases (e.g., boost, mid-course, and terminal); as well as utilizing different types of platforms and interceptors (e.g., ground, ship, air, and space launch of kill vehicles) and/or utilizing high-energy laser kill mechanisms; and combining a variety of terminal sensors and utilizing a wide range of techniques for discrimination of decoys from warheads, such as multispectral sensors (e.g., infrared and X-band radars), or even pushing a gas cloud out front of an exoatmospheric interceptor to separate the heavy warhead from the decoy balloons.[3]

[3] This idea was suggested by Richard Garwin.

Chapter 4

Costs

Naturally, the cost of any missile defense system will vary widely as a function of the type of system and its complexity. Therefore, the early ground-based, terminal-phase systems (with their limited range intercept systems) would require a very large number of interceptor locations around the country, in order to defend the cities and critical sites at which they were located. In 1966, Defense Secretary McNamara estimated a cost of about $15 billion for enough firepower to defend a significant part of the country (over $100 billion in today's dollars).[1] Later that year, he said that a "limited" system, aimed at protecting some cities against a few unsophisticated Chinese missiles, would be very effective and only cost $8 to $11 billion (around $50 billion in today's dollars).[2]

The limited NMD system that was developed during the Clinton Administration began at a level of around $4 billion a year, and was accelerated by the George W. Bush administration. It was estimated to have an initial deployment cost of under $20 billion for the single site in Alaska, plus an added $10 to $15 billion for upgrading.[3] The General Accounting Office (GAO) estimated the cost for deployment and 20 years of operation of the limited NMD system (including the space-based infrared warning and tracking systems and 100 ground-based interceptors) would be about $60 billion. Finally, a 1988 estimate for a space-based system done by the independent Cost Analysis Group of the Pentagon put a laser-based defense system's total deployment at around $115 billion. It also stated that if the program were structured to eliminate the lasers and have a more limited deployment on a space-based system (such as using kinetic interceptors), it would cost around $55 billion (both estimates in 1988 dollars).

What is important about all of these numbers is that they are very large. However, if this is a high-priority program, *they are affordable*

[1] Donald R. Baucom, *The Origins of SDI 1944-1983*, University of Kansas Press, 1992, 17.
[2] Ibid, 26.
[3] Stephen J. Hadley, "A Call to Deploy," *The Washington Quarterly*, Summer 2000.

within an annual defense budget that is well over $500 billion a year (recognizing that the large estimates for the full deployment and support of any of the systems are divided over a significant number of years). For example, the GAO cost estimate of $60 billion over 20 years is $3 billion per year—or (on average) less than 1 percent of the annual DOD budget (even after adjusting for inflation). The early-year costs would, of course, be higher, and thus compete with other high-cost priorities.

To answer some of the basic questions about BMD—and in particular the two critical questions, “can it be done?” and “should we do it?”—it is necessary to put the current situation into perspective by examining the long history of ballistic missile defense.

Chapter 5

Historic Highlights

Phase I: 1944 –1972 (from the V-2 to the ABM Treaty)

1944—The first V-2 ballistic missile attacks on England. (The "V" stood for *Vergeltungswaffe*, which means vengeance weapon; it was aimed at killing civilians).

1945—The first atomic bomb is dropped on Japan.

1946—After the war, the United States learns that Germany had plans for an intercontinental missile to hit New York (in 1946!).[1] U.S. efforts at ballistic missile defense begin (under Project Defender), with two contracts to develop a defensive missile. (The programs were known as "Wizard" and "Thumper.")

1949—Soviet Union tests an atomic device.

1955—Soviet Union begins development of a ballistic missile defense system (which was not publicly announced until 1966).

1957—First Soviet ICBM test. U.S. Intelligence estimates that the Soviet Union will have 500 ICBMs by 1962.

—Soviet launch of Sputnik, the first satellite.

—U.S. Army NIKE/Zeus anti-ballistic missile program begins. It was an expansion of the NIKE anti-aircraft missile through the utilization of a nuclear warhead.

1958—The Advanced Research Projects Agency (ARPA) is founded, largely in response to the launching of Sputnik. It later became the Defense Advanced Research Projects Agency (DARPA). ARPA begins broad-based research and development work on defense against Russian missiles, under the Project Defender program; funded at approximately $200 million per year (in 1958 dollars). A number of different options were explored, such as lasers and particle beams for kill mechanisms, and a space-based boost-intercept system (known as "BAMBI"), intended to utilize kinetic-kill mechanisms and infrared homing. ARPA also examined a satellite-based detection and tracking

[1] MDA Historian, "Hit-to-Kill Intercept Tests," Introduction, August 8, 2009.

system with ground-based interceptors, designed to meet their mid-course targets over the North Pole, and utilize nuclear warhead kills (one option had a ground-based radar located in Norway). Another concept they explored was known as “ARPAT” (for ARPA Terminal), in which unmanned vehicles loiter at an altitude of 60,000-foot, armed with interceptors that could be fired on guidance commands. These commands would be initiated after ground-based radars performed atmospheric sorting of the reentry vehicles from the decoys; the vehicles would then perform a kinetic kill of the warheads. Finally, “Project Defender” did a great deal of work on the development of large, ground-based, phased-array radar systems (the first was finished in 1960). This led to the demonstration of the ability to electronically steer a radar beam in two dimensions, using computers to control the beam. This has become a key element in ballistic missile defense systems, for both tactical and strategic purposes, replacing the prior, mechanical slewing of an antenna.

—First U.S. ICBM (ATLAS) intercontinental flight.

1959—A major milestone in the history of anti-missile technology: a ballistic missile is intercepted for the first time. Intercept was achieved by modifying the Hawk anti-aircraft missile’s radar receiver’s speed-gate to handle the higher closing velocities of missile-to-missile intercepts. It was able to shoot down an Honest John tactical ballistic missile at the White Sands test range.

—U.S. Navy initiates (again, in response to Sputnik) an anti-satellite program known as “Early Spring,” to be launched from a Polaris missile in mid-ocean (so that the source would be unknown) and intercept the satellite at the apogee of the interceptor’s trajectory. It would then use terminal homing for the intercept. The program was announced to Congress in 1961, but the White House terminated it in the late ‘60s for political reasons.

1962—First ICBM “intercept,” by the NIKE/Zeus missile, is achieved. Interceptor was launched from Kwajalein, in the Marshall Islands of the South Pacific, against a Minuteman ICBM launched from the Pacific Missile Range; the “intercept” was based on the miss-distance required for a kill using a nuclear warhead. (This is the identical geometry for the launch and first intercept of the NMD system in 1999, 37 years later, which utilized a hit-to-kill missile.) Simulations (on an analog computer) estimated that the ballistic missile defense system would be highly accurate, and the intercept by the NIKE/Zeus proved this to be

the case. However, the successful NIKE/Zeus intercept did not lead to system deployment. The stated reasons for this were:

1. Questionable discrimination capability.
2. Concerns regarding the nuclear warhead detonation effects.
3. High costs of the system.

—The similarity of the flight test results of the NMD system intercepts, almost 40 years later, provoked the same questions, and the same programmatic results: i.e. “begin studies of alternatives, and continue the R&D—no deployment.”

—Then came the Cuban Missile Crisis. This clearly made the possibility of an exchange of nuclear-tipped ballistic missiles between the United States and the Soviet Union more credible—drawing renewed attention to defensive systems.

1963—NIKE X begins. This was a layered system with the Spartan missile (an extended-range NIKE/Zeus) for intercepts in space (prior to re-entry) and the Sprint missile (a shorter-range, high-acceleration missile) for atmospheric intercepts. Both systems used nuclear warheads for the target kill, and the low-altitude intercept of the Sprint required that the radars be hardened against the detonation of its own nuclear warheads. Additionally, Secretary McNamara announced that fallout shelters were required for the population, as the Soviet Union could detonate nuclear weapons upwind of the defended region, and the radioactive fallout could spread to the target area. Also, there would be fallout from the defense system’s nuclear detonations.

—A “partial nuclear test ban treaty” is signed. This treaty was strongly opposed by many ballistic missile defense proponents (then, and in the following years) because they wanted to begin atmospheric testing on the warhead of the NIKE/Zeus. (Arguments about nuclear testing have revived recently, as many nuclear scientists want to resume testing to assure the performance of nuclear warheads on U.S. strategic offensive weapons on the grounds that it is necessary to preserve nuclear deterrence.)

1964—Soviet “Galosh” anti-ballistic missile system detected. It was a ground-based system utilizing nuclear warheads for the kill mechanism. It was to be deployed around Moscow.

—By the end of 1964, a number of leading U.S. scientists said that the NIKE/Zeus system should not be deployed. They believed that it would be ineffective and destabilizing. They also stated that it would be

"virtually hopeless" to develop an effective system.[2] Other leading scientists took the opposing position, as was the case over 35 years later, when leading scientists argued on both sides of the debate regarding NMD.

—The "Betts Commission" Report, ordered by Secretary McNamara, found that:

1. The offensive and defensive technologies of the United States and the Soviet Union were roughly parallel.

2. Ballistic missile defense would limit the loss of U.S. lives and property.

3. Ballistic missile defense would not disrupt the balance of deterrence.[3]

—China explodes a nuclear device, leading Secretary McNamara to examine how the NIKE X might be modified to cope with the kind of "light, unsophisticated attack" ("Nth country threat") that China might be able to mount in the 1970s. Again, this shift, from an exclusive focus on the Soviet Union to a focus on a "light" system against an "Nth country," has direct similarities to the shift that took place in the 1990s, when the United States refocused its system from Russia to "rogue nations."

1966—China demonstrates both an atomic weapon and an Intercontinental Ballistic Missile (ICBM).

—Secretary McNamara announces that the Soviet Union is fielding an ABM system around Moscow, known as "Galosh," and that it had been under development in the Soviet Union since 1955. This led to initial discussions of an ABM Treaty, and increased efforts by the United States to develop penetration aides against the Soviet's defense system.

—Congress and the Joint Chiefs wanted to deploy the NIKE X system, but Secretary McNamara, President Kennedy and later President Johnson did not.

1967—The United States decides to deploy the Sentinel system against China. It was a limited defense system not aimed at the Soviet Union (it could not handle multiple reentry vehicles, which the Soviet Union

[2] Donald Baucom, *The Origins of SDI* (Lawrence, KS: University of Kansas Press, 1992), 21–22.
[3] Ibid, 22–23.

had). The "Sentinel" system was a layered system based on the Sprint and Spartan missiles.

—McNamara argues that because the Soviet Union and the United States each has a second-strike capability (i.e., from a land-mobile or submarine-based ICBMs, that could survive a first strike), a limited anti-ballistic missile system would be worthless for either of them. Thus, a limited BMD system against an unsophisticated nth country, without a second-strike capability, was the only one that made sense—and it clearly would be no threat to the Soviets. This, of course, is the argument that is being advanced today, due to the fact that the limited U.S. National Missile Defense system will only be used against rogue nations and would be useless against Russia or even China (once China deploys its mobile and sea-based systems). McNamara did state, however, that the system could be used for an accidental Soviet launch. Once again, this same argument resurfaced almost 40 years later during the George W. Bush administration.

—Soviet Premier Kosygin stated "Defense is moral; Offense is immoral." As Henry Kissinger later added, the Soviets never accepted the idea that vulnerability was a desirable characteristic, as required under the mutual assured destruction concept.

—Secretary McNamara said that the U.S. reaction to the Soviet deployment of a ballistic missile defense system would not be the deployment of more U.S. defensive systems; instead, it would be the deployment of more and better offensive systems. Interestingly, this is the same position, but reversed, taken by Russian President Putin in 2001, declaring Russia would increase their offensive ICBMs when President Bush and Secretary Rumsfeld declared that they would break the ABM Treaty and deploy the U.S. NMD system.

—The United States successfully demonstrates two types of inertially guided, maneuvering reentry systems launched as payloads on ICBMs and intended to defeat the Soviet Galosh system.

1969—President Nixon announces the decision to deploy anti-missile systems around two Minuteman sites, with a growth capability to 10 sites, to handle the developing Chinese threat. He called this system "SafeGuard." It was the same as the Sentinel system, but was intended to guard missile sites rather than cities. Interestingly, 40 years later, the fear in both Russia and China was that the "limited system" then being deployed in Alaska might grow to handle both the Chinese and Russian threat, instead of its intended use against rogue nations.

—With the decision to deploy SafeGuard around Minuteman sites, the ABM debate heated up again. Scientists went on strike, held mass meetings, and marched on Washington—all in protest of the planned SafeGuard limited deployment. Congress was split on the issue (with the Senate divided 50/50 on votes), as were scientists. The public was generally in favor, with various polls showing from 47 percent to 84 percent approval, but many were uninformed and/or indifferent.

—Because nuclear parity between the United States and the Soviet Union had been reached by the end of 1968 (with each country capable of withstanding a first strike and having an effective second strike), it was concluded that no one could “win” a nuclear exchange. It was also decided that mutual assured destruction, at the levels of the offensive weapons then in existence on both sides (and even below), would justify the initiation of strategic arms control negotiations and subsequent arms-reduction agreements.

1970—SafeGuard deployment begins in Grand Forks, North Dakota, around the Minuteman silos. It was approved in the Senate by a vote of 51 to 49. It was argued that the decision to begin deployment would be a “bargaining chip” to persuade the Soviets to reduce the number of strategic missiles—and, if they agreed, there would be no need for the deployment. (This was perhaps the first linking of treaty negotiations on offense limits with defensive systems, a precursor to future negotiations.)

1972—Both the ABM Treaty (limiting anti-ballistic missile systems) and the Salt I Treaty (limiting strategic offensive weapons) are agreed to by the United States and the Soviet Union. Thus, the SafeGuard deployment was halted (although inertia kept it going for 4 more years). The assumption was that each side would effectively remain defenseless—even though each was initially allowed two defensive sites (which 2 years later was reduced to one defensive site). Thus began the era of mutual assured destruction as the basic strategic policy of the United States.

—As part of the ABM Treaty agreement, each country agreed not to deploy ABM systems for the defense of its national territory, nor create a base for such a defense. They also agreed that a maximum of 100 ABM interceptors and launchers could be deployed at the two sites (either the national capital or an ICBM deployment area). They also agreed that each country would accept restrictions on the number, power, and location of ABM radars and other radars that can be used in

place of an ABM radar. Finally, they both agreed not to develop, test, or deploy sea-based, air-based, space-based, or mobile land-based ABM systems.

Phase II: 1973-1983 (from the ABM treaty to the SDI)

1974—The ABM Treaty is amended so that each side would have only one site (Moscow and Grand Forks, N.D.).

1976—With the ABM Treaty in place and the bargaining-chip rationale gone, Congress cancels the funding for the ABM system; dismantlement was completed the same year. Even though the site for SafeGuard was allowed by the treaty, the same concerns about its viability still existed, especially in the areas of discrimination and kinetic (vs. nuclear) kills—two of the major uncertainty areas of the systems historically, and to date. Other areas in which research continued (in addition to discrimination and hit-to-kill technology) included high-energy lasers (with demonstrations by each Service on an airplane, a ship and a vehicle) and the laser's integration with precision pointing and tracking systems. (ARPA had been funding research on high-energy lasers for ABM since 1961, under project "Seaside.")

1978—The Joint Chiefs of Staff order that work begin on a "low-risk Anti-Satellite system using off-the-shelf technology… employing pellets as its kill mechanism."[4] (However, the description of this system was never made public.)

1979—The Soviet Union invades Afghanistan.

1981—Ronald Reagan is elected, and begins internal discussions on the formulation of a policy for defense of the country against ballistic missile threats. The prior year, he and the Republican Platform had made a joint statement that "the Republicans reject the Mutual Assured Destruction (MAD) strategy … which limits the President during crisis to the Hobson's Choice between mass, mutual suicide and surrender." They went on to urge "vigorous R&D of an effective ABM system."

1982—Army tests prototype hit-to-kill, exoatmospheric Homing Overlay Experiment (HOE), from Kwajalein on a modified minuteman rocket.

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[4] Federation of American Scientists website (regarding "Early Spring"), http://www.fas.org.

1983—President Reagan announces the Strategic Defense Initiative (SDI), in which he rejects MAD in favor of "defense for the country."[5] His concept was to be based on space-based laser kills, and was to "assure survival for us and our allies." He also offered to share it with the Soviet Union, "so that all countries could be protected."

—Opponents immediately named SDI "Star Wars," while Reagan emphasized that it would save lives, not avenge them. Yet he clearly recognized the difficulty, costs, and time required to develop the system.

—Importantly, Reagan said that he wanted to keep within the constraints of the ABM Treaty (which explicitly prohibited space-based systems); so he must have had in mind a treaty revision that could be mutually agreed to.

Phase III: 1984 to 1993—(Strategic Defense Initiative)

1984—The Strategic Defense Initiative Organization (SDIO) is established.

1985—A Titan Rocket is destroyed by an infrared, advanced chemical laser.

1987—A layered defense system is planned, with space-based boost-intercept, and ground-based, mid-course and terminal phases, and with space and ground-based sensors. The United States continued to pursue the full range of R&D options. A program called "Brilliant Pebbles," containing 1000 space-based interceptors, and space-based "Brilliant Eyes" to do tracking and discrimination, was investigated (reminiscent of the 1958 "BAMBI" system, the space-based kinetic-kill ABM system). Also, ground-and ship-based theater and national defense systems were continued.

1989—Berlin Wall falls. Collapse of the Warsaw Pact.

1991—Collapse of the Soviet Union. The "Cold War" officially ends.

—President George H.W. Bush announces a refocused SDI, called GPALS (for Global Protection Against Limited Strikes). The strategy had three parts:

1. A theater defense system for U.S. troops and allied nations.

[5] For a full discussion of SDI, see Donald R. Baucom, *The Origins of SDI, 1944-1983 (Modern War Studies),* University Press of Kansas, 1992.

2. A national system which was ground-based and treaty compliant (sic) to protect the American people.

3. A space-based global system for small (nth nation) attacks against any country.

—The Gulf War, which many claim was the last of the 20th Century "conventional" conflicts (i.e., massed tanks on the battlefield).

—The first operational military engagement between ballistic missiles and ballistic missile defenses; Patriot missiles are used against Iraqi Scuds during the Gulf War.

—A Scud launched from Iraq achieves the first U.S. casualties from a ballistic missile when it hits military barracks in Dhahran, Saudi Arabia, killing 28 soldiers and wounding 99.

1993— President Bush and Russian President Yeltsin sign START II.

—The Strategic Defense Initiative is ended by President Clinton. The program office is renamed the Ballistic Missile Defense Organization and focus shifts to defending against a few, relatively-unsophisticated, long-range missiles, launched from "rogue nations" to destroy the United States—as well as having a secondary role in maintaining defensive capability against an inadvertent launch of a Russian missile. The concept of mutual assured destruction was no longer being questioned; it would remain the basis for the strategic balance between the United States and Russia. However, "limited" missile defense would be the new focus, aimed at "rogue" nations.

Phase IV: 199 –2001 (from the end of SDI to 9/11)

1994—Start I enters into force, establishing a limit on strategic missile numbers for the United States and Russia.

—The Republican Party's "Contract with America" calls for renewed commitment to National Missile Defense.

1995—First flight test of the Army's ground-based, Terminal High Altitude Area Defense (THAAD) system.

1996—The National Missile Defense (NMD) program officially begins. It was to be a ground-based system, utilizing "hit-to-kill" targeting as the kill mechanism, in order to assure the vaporization of biological or nuclear warheads. Its eventual location was to be Alaska, in order to protect all 50 states. It would use space-based sensors and ground-based radars. The R&D undertaken would be compatible with

the ABM Treaty, though it was recognized that when deployment began there would have to be treaty modifications (or an abrogation by the United States; with 6 months warning to the Russians).

—Also, the first multinational, anti-ballistic missile program was established that year. The program was known as MEADS (Medium Extended Air Defense System), and it was to be a mobile, theater system for defending maneuvering forces of the United States, Italy and Germany, as well as fixed installations, against tactical ballistic missiles, low and high-altitude cruise missiles and all forms of aircraft. Its design was to be based on the U.S. Patriot PAC-3 missiles (originally anti-aircraft missiles), with Ka-band radar terminal homing.

1997—The Ballistic Missile Defense Organization establishes a joint (multiservice) program office to design and develop the NMD system; to be completed by the year 2003—a highly optimistic goal. However, this date was set in recognition of growing worldwide proliferation of long-range ballistic missiles, and with considerable Congressional pressure in mind. It would be "possibly achievable," if everything went perfectly.

—President Clinton and Russian President Yeltsin agree on an outline of the START III treaty, reducing nuclear arsenals to between 2,000 and 2,500 warheads each.

1998—India and Pakistan test nuclear devices.

—North Korea tests a long-range missile (the Taepodong-1), which was fired in a trajectory over the island of Japan. It was observed that they also had the Taepodong-2 under development, and that it could reach Hawaii and Alaska from North Korea.

—The "Commission to Assess the Ballistic Missile Threat" (known as the Rumsfeld Commission,[6] for its chairman Donald Rumsfeld) found that ballistic missiles pose a growing threat to the United States, and that a number of potentially hostile nations could have the ability to inflict major damage on the United States within about 5 years of seeking to acquire such a capability.

—A separate study by the National Defense Industries Association reached similar conclusions. They emphasized the political ramifications of a third-world country coming to possess a relatively

[6] *Report of the Commission to Assess the Ballistic Missile Threat*, 1998, Washington, D.C.

inaccurate, unreliable missile equipped with a chemical or biological warhead—even if it was never launched.[7] They found that "third-world countries willing to accept limited performance, and choosing to use innovative approaches, can develop or otherwise acquire a long-range ballistic missile capable of striking parts of the United States within 3 to 5 years."

—Defense Secretary Cohen stated that missile defense is now a key element of U.S. strategic strategy, within the context of the ABM Treaty and the Start II and Start III environment (the expectation being that future negotiations with Russia on the ABM Treaty modifications would include a combination of offense and defense).

1999—The National Missile Defense Act is passed by Congress and signed by President Clinton. This Act commits the nation to NMD "as soon as technically feasible—and if affordable and within the overall national security interest of the nation."

—America and Russia resume strategic arms talks that include modification of the ABM Treaty.

—The first integrated flight test of the National Missile Defense System is performed with an interceptor launched from Kwajalein in the Marshall Islands. The interceptor is deployed against a Minuteman launched from the Pacific Missile Range. A decoy is also launched. Although initially targeted by the interceptor, it is able to correctly distinguish the decoy from the true missile, shifting its focus to the re-entry vehicle target. It achieved a direct hit, causing an evaporation of the target warhead.

—DOD adds budget funds that would allow it to deploy an NMD system, should it prove desirable.

—NATO initiates studies of multinational ballistic missile defense systems.

2000—The second and third integrated flight tests of the overall National Missile Defense System both experience reliability failures. The first has an interceptor cooling system failure about 5 seconds before intercept; the second has a booster-warhead interface system failure, so the kill vehicle is never released.

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[7] National Defense Industry Association, Washington D.C., 1998, 77.

—The Union of Concerned Scientists and MIT release a report challenging the effectiveness of the planned anti-missile system against countermeasures.

—President Clinton decides not to authorize work to begin to deploy the National Missile Defense System because the technology has yet to be proven. The R&D program is to remain on track.

2001—In his confirmation hearings, Defense Secretary Rumsfeld refers to the ABM treaty as "ancient history."

—Russia, China and North Korea formally tell the U.N. Disarmament Commission that a U.S. missile defense system would threaten international security; trigger a new arms race; and undermine the ABM Treaty. This was a culmination of comments received from many countries (including numerous, historically-strong allies of the United States), questioning whether or not it was worth destroying the ABM Treaty over deploying a U.S. National Defense Missile System.

—President George W. Bush calls for a Missile Defense System; with funding for the program, in his first budget (Fiscal Year '02), set to dramatically increase.

—The fourth integrated system test of the NMD system achieves a successful intercept, making the record 2 successes out of 4 attempts.

—President Bush announces his plan to establish an ABM Treaty-compliant missile test range in Alaska; which could be converted to an initial National Missile Defense System as early as 2004.[8] Also, it is recognized that the United States can begin testing of future sea, air and space-based systems as long as the testing is done on the land (which would be in accordance with the ABM Treaty).

—President Bush (in a speech at the National Defense University) announces his potential future intent to examine basing options for a missile defense system in Eastern Europe.

Phase V: Post 9-11

2001—In December, President Bush announces the intent to withdraw from the 30-year-old Anti-Ballistic Missile Treaty and agrees to significant missile cuts by the United States and Russia.

—The Ballistic Missile Defense Organization is renamed the Missile Defense Agency (MDA) to give it greater prestige; with an

[8] *Los Angeles Times*, June 28, 2001.

approximate doubling of its budget and a major restructuring and expansion of the overall program.

—Three successful intercepts in a row (by the NMD system) provide increased confidence in the ability to consistently "hit-to-kill" at intercontinental ranges (with the "score-card" reading five successes out of seven flights—and the two failures being due to parts unreliability, not design deficiencies).

—The focus of the ballistic missile defense program shifts to the integration and consolidation of a few, next-generation, layered systems, covering the domains that had previously been referred to as "theater" and "strategic" systems, and including defense against increasingly-sophisticated decoys.

—There is growing interest in the United States, Europe, and Asia about the importance of multi-national considerations in ballistic missile defense.

—China conducts a full-scale anti-missile test.

—Anthrax attack on Capitol Hill raises concerns about multiple, small biological warheads.

2002—Bush Administration "National Security Presidential Directive 23" officially withdraws from the ABM treaty and commits the United States to deploy an initial [national] missile defense capability in 2004 (released to the public in May 2003); which represented a withdrawal from the 1972 Anti-Ballistic Missile Treaty with the former Soviet Union.

—Russia strongly objects to U.S. deployment of BMD missiles in Poland and radars in Czech Republic (claims they are "a threat to Russia") and states they will respond with increased ICBMs.

2003—MDA temporarily suspends plans to move forward with a space-based, kinetic-energy, boost-phase intercept program, claiming the technology is not mature enough.

—DOD selects Adak, Alaska for a sea-based, X-band radar (on a self-propelled, modified oil-drilling platform) to perform detection, tracking and discrimination.

2004—ABM missiles began entering Fort Greely, Alaska silos.

—Russian Topol-M long-range (6000 miles) deploys initial mobile (off-road) version (of the silo-based system).

—Abdul Qadeer Khan admits that he had passed on Pakistan's nuclear technology to Libya, North Korea, and Iran (often via Dubai, in UAE).

—Funds requested to expand U.S. missile defense system to Europe (sites to be determined).[9]

—Airborne laser runs into cost and technical problems (overrun by $2 billion).

2005—NATO officially adopts the U.S./German/Italian MEADS for theater missile defense (with deployment around 2012).

—Secretary Rumsfeld directs that cruise missile defense not be under the Missile Defense Agency.

—Missile defense budget (under President Bush) grows to $9.9 billion (from $4.2 billion).

—Japan increases its emphasis on missile defense.

—MDA initiates unmanned, high-altitude airship (to hover above 60,000 feet with 500 pounds of sensors)

2006—MDA pushes Multiple Kill Vehicle (MKV) to allow over 20 kill vehicles (for exoatmospheric kills) in space formerly occupied by a single kill vehicle.

—SM-2 achieves intercept of long-range ballistic missile in terminal phase; prior intercepts had been boost or mid course.

—United States has deployed 10 interceptors (at Fort Greely, Alaska and Vandenberg Air Force Base, California) and Congress approves initial funding for third site (in Europe).

—Russia announces development of maneuverable warheads to penetrate missile defense systems.

—Iran launches Shahab-2 and Shahab-3 missiles in "Gulf War Games."

2007—China performs a successful anti-satellite weapons test, destroying an aging Chinese weather satellite target at over 500 miles altitude with a kinetic kill vehicle launched on a ballistic missile (results in a large number of space debris objects).

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[9] Robert Wall, "Growth Path," *Aviation Week and Space Technology*, February 2, 2004, 31.

—Army soldiers at Pacific Missile Range conduct a successful "high endoatmospheric" (just inside Earth's atmosphere) intercept of a "SCUD-type" ballistic missile launched from Hawaii.

—An NMD interceptor was launched from Vandenberg Air Force Base in California and successfully hit (and killed) a threat-representative target, launched from Kodiak, Alaska. The full NMD system (satellite warning, multiple tracking radars, etc.) was utilized.

—Japan Maritime Self Defense Force (utilizing their Aegis ship and a Standard Missile-3 (SM-3)) on December 17th successfully intercepted a ballistic missile approximately 100 miles above the Pacific Ocean.

—Japan also deployed land-based PAC-3 (for the first time) as a "second layer," to complement the ship-based SM-3, against North Korean launches.

—Russia tests a mobile ICBM (SS-24) capable of carrying multiple, independent warheads; which they state was intended to overcome missile defenses.

2008—United States shoots down errant U.S. spy satellite with a modified, high-altitude SM-3 (to prevent earth impact of a 1,000-pound tank of hazardous hydrazine rocket fuel).[10]

—President Bush received agreement from Czech Republic and Poland to deploy BMD sites (missiles and radars) in Eastern Europe (for defense against Iranian launches). Russia strongly objects.

2009—Japan purchases sea-based SM-3 and ground-based THAAD for defense against North Korean launches.

—United States and Russia agree to a joint facility for monitoring missile launches around the world (a clear confidence building action). They also agree to cut nuclear arsenals; to work together to assess threats posed by countries such as Iran and North Korea; and to further explore cooperation in missile defense (clearly linking future control agreements to a combination of offense and defense actions).

—Secretary Gates cancels airborne laser program production—due to costs, as well as operational and technical issues.

—President Obama requests DOD to cut missile defense budget for 2010 by approximately $2 billion.

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[10] N. Kaufman and J. White, "Spy Satellite's Downing Shows a New U.S. Weapon Capability," *Washington Post*, February 22, 2008, A03.

—North Korea conducts an underground nuclear weapons test, and Deputy Secretary of Defense Lynn testifies that within 3 years (i.e. by 2012) North Korean missiles could hit the United States.

—Iran tests a multi-stage, solid-propellant missile with a range of 1,200 to 1,500 miles, putting much of Europe within range.

—Secretary Gates approves deployment of THAAD missile defense weapons and radar system to Hawaii in case of a North Korean launch.

—House Armed Services Committee approximately triples the procurements of THAAD and SM-3 missiles, and approves 30 of the National Missile Defense missiles for deployment in Alaska and California.

—President Obama announces change in plans for European BMD deployment, from Eastern Europe to ship-based and future land sites (to be determined).

2010—In response to a Congressionally-mandated direction, on February 1, 2010, Secretary of Defense Gates released the results of an 11-month study[11] stating: “The protection of the United States from the threat of ballistic missile attack is a critical national security priority.” It was to be “a small number of long-range ballistic missiles.”

—The report also states: “The ballistic missile threat is increasing both quantitatively and qualitatively, and is likely to continue to do so over the next decade.”

—Finally, the report emphasizes the “important priority” of taking a multinational perspective on this issue. Specifically, it states: “In Europe, the Administration is committed to implementing to new European Phased Adaptive Approach within a NATO context.” In East, Asia, the U.S. is utilizing “a series of bilateral relationships.” It is “pursuing strengthened cooperation with a number of partners in the Middle East.” And, it “seeks to engage Russia and China on missile defense.” (Specifically noting that with Russia this includes “shared early warning of missile launches, possible technical cooperation, and even operational cooperation.”)

[11] “Ballistic Missile Defense Review Report,” Department of Defense, February 2010.

—The People's Republic of China (PRC) announced on January 11 that it had successfully tested a "ground-based, midcourse missile interception technology."[12]

[12] L.C. Russell Hsiao, "In a Fortnight: Aims and Motives of China's Recent Missile Defense Test," Jamestown Foundation, "China Brief," Volume X, Issue 2, January 21, 2010.

Chapter 6

Proliferation

In 1998, significant amounts of unclassified information began to appear about the rapid proliferation of ballistic missile systems—first in the Rumsfeld report, and later from both independent groups and Congressional Committees. Specifically, the Rumsfeld report maintained that “some 25 or 30 countries have, or are seeking to develop, ballistic missiles capable of delivering chemical, biological or nuclear warheads to portions of, or all of, the United States.” In 2006, more than one hundred *foreign* ballistic missiles were launched around the world[1] (with the non-U.S. ballistic missile flight tests growing at about 10 percent per year).[2] North Korea launched multiple, short-range ballistic missiles (SRBMs) and medium-range ballistic missiles (MRBMs) on July 4, 2006, and a Taepodong-2 ICBM. Iran staged coordinated, near-simultaneous launches of multiple SRBMs and its Shahab-3 MRBMs in November 2006 and again in January 2007. (And, it is known to be developing a 2,000-kilometer-range variant of its deployed Shahab-3 ballistic missile.[3]) In 1998, the U.S. Senate Committee on Government Affairs identified Russia, China and North Korea as principal proliferators.[4] They also pointed out that the leakage of nuclear, biological and chemical information from Russia, driven by the economic needs of Russian scientists, was of grave concern. They specifically noted that Russia, China, the U.K., France, and the United States already had nuclear weapons, and that Israel, India, Pakistan, and South Africa had demonstrated the ability to produce nuclear weapons, and North Korea and Iraq were pursuing them. They further noted that had China provided technical assistance and complete ballistic missile systems to North Korea, Pakistan, Syria, Iran, and possibly others.

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[1] MDA Fiscal Year 2008 Budget Estimates Overview, 3.
[2] Craig Covault, “Eyes on China and Iran,” *Aviation Week and Space Technology*, April 9, 2007, 51.
[3] Testimony of Vice Admiral Lowell E. Jacoby, USN, Director, DIA, before the Senate Armed Services Committee, March 17, 2005.
[4] Committee on U.S. Government Affairs, U.S. Senate, *The Proliferation Primer* (Washington DC: Government Printing Office, 1998).

In 2004, Mohammed ElBaradei, Director General of the International Atomic Energy Agency (IAEA) stated that 40 countries could make a nuclear bomb if they wanted to.[5] China is known to be developing a ground mobile and a submarine-based intercontinental missile system capable of reaching the United States—both aimed at overcoming missile defenses. The latter (the Julang 2 missile) carries multiple, independently-targeted warheads; 16 of these missiles could be carried by the type 094 nuclear submarine.[6] The deployment of SLBMs would give China second strike capability, which clearly puts China into a special "second-strike category," along with Russia.

Iran, Iraq, and North Korea also have significantly stepped up their efforts on advanced missiles and weapons.[7] Results were expected over a 10 year period, and many capabilities have already been demonstrated. The North Korean No Dong system (based on the Russian Scud) is the basis of Iran's Shahab-3 and Pakistan's medium-range missile.[8] As demonstrated by the launch of the Taepodong-1, North Korea is the most advanced of these three nations. While the Taepodong-1 warhead can only bear the weight of biological or chemical warheads if launched toward the United States (still a considerable threat), the Taepodong-2 can carry such payloads as early generation nuclear weapons toward the United States. Finally, the CIA stated[9] that in the year 2000, Russian, North Korean and Chinese "entities" supplied fresh ballistic missile-related equipment and knowledge to Iran; in this time period, Iran was "pressing ahead with an effort to develop a domestic capability to build chemical, biological, and nuclear weapons," plus their delivery systems. In 2001, they estimated that Iran would have a capability to reach portions of the United States "within 15 years." Further, a November 2006 Congressional Research Service report noted that Israeli intelligence

[5] BBC News, "Nuclear Weapons Proliferation," September 23, 2004.
[6] Edward Cody, "China Builds a Smaller, Stronger Military," *Washington Post*, April 12, 2005, A01.
[7] Shelby G. Spires, Third World poses top missile threat, CIA official says, *Huntsville Times*, August 22, 2001.
[8] Vernon Loeb, "Preparing for 'Network-Centric' Warfare," *Washington Post*, August 27, 2001.
[9] "CIA Says Iran Got New Missile Aid," *Washington Post*, September 8, 2001.

stated that North Korea had shipped to Iran eighteen 1,500 mile range BM-25 ballistic missiles capable of carrying a nuclear warhead.[10]

By 2009, the total number of ballistic missiles worldwide—*excluding* the United States, Russia, China, and NATO—was over 5,900.[11] The Asian scholar Paul Bracken wrote earlier, in "Fire in the East," "The spread of missiles and weapons of mass destruction in Asia is like the spread of the six-shooter in the American Old West."[12] It is a cheap and deadly equalizer, and more likely to be used by the poorer countries.

While 10- or 15-year projections of ballistic missile threat capabilities may seem too distant to warrant immediate countering strategies, it should be emphasized that the development of a sophisticated U.S. military system typically takes 15 to 20 years before it can be fully fielded. Thus, these threats to the United States and its allies need to be addressed in the near term. Stopping their development is obviously the best approach to take. However, because this cannot be guaranteed, the "insurance policy" of a defense system against such threats appears warranted.

[10] Craig Covault, "Iran Set to Try Space Launch," *Aviation Week and Space Technology*, January 26, 2009.
[11] Lt. General O'Reilly, National Defense University Conference, June 2, 2009.
[12] As quoted in "Missile Defense in Asia" (Washington, DC: The Atlantic Council, June 2003).

Chapter 7

Multinational Defense Considerations

In the last few years, other countries have begun to recognize that the ballistic missile threat is more and more real, perhaps even more so for them, since many— for example, Europe, Japan, Taiwan, South Korea, Israel, and India — are closer to the likely launch sites.

There has also been an increasing focus on the *multinational* need to address a combination of anti-proliferation actions and modifications to various treaties. The goal is to maintain the overall strategic regime, established by both the offensive and defensive treaties that have been, or were, in effect for years, and bring them up to date for the new, globalized environment.

A focus on international considerations also becomes a high priority, in light of three important facts: 1) threats against our allies significantly impact America's own options; 2) the United States requires its allies' cooperation for warning and discrimination-enhancing radars on their territories; and, 3) the United States needs geopolitical support if it is to go ahead with its own program.

In 1999-2000, NATO initiated two major studies on the design of joint, multinational missile defense systems that would protect all NATO countries. One of the explicit issues to be addressed was not just the technical question of "can it be done?" but the economic question of "who would pay for it?" This is a significant dilemma for many European countries, as many of their leaders have explicitly acknowledged the existence of the threat, yet have not budgeted for any defense against it. (For example, in 2004, the U.K. spent only $9 million on missile defense.) Finally, perhaps the most difficult issue is the development of agreements (in this multinational environment) of a rapidly-responding command and control system to operate in the "seconds" between target launch-detection and interception.

A first step toward a multinational missile defense system was the joint U.S./German/Italian development of a theater, mobile, anti-missile system, known as MEADS (Medium Extended Air Defense System). Technology was initially being shared among the three countries for this program, with the intention of having a deployable and interoperable system to protect the three nations' troops as soon as possible. Then, in 2005, the system was officially adopted by the 26 nations of NATO. However, this still begs the "strategic" (i.e., national) issue of a multinational defense system for Europe (possibly involving the United States).

With the growing recognition of the threat to Europe (and elsewhere) of ballistic missiles, the heads of state issued a statement at the NATO Summit on April 4, 2009 that "ballistic missile proliferation poses an increasing threat to Allies' forces, territory, and populations. Missile defense forms part of a broader response to counter this threat."[1] The plan is for a layered defense, combining the multinational MEADS (utilizing the U.S. PAC-3 missile) with the French/Italian SAMP/T (based on the French Aster 30 missile). It has been stated that this overall system is likely to be the largest and most complex cooperative project ever undertaken.[2] The U.S. General Accountability Office (GAO) estimated the cost for the proposed NMD European interceptor and radar *sites alone* (excluding the weapons, radars, etc.) at approximately $1 billion.[3] And the combined "theater" systems (of which many more are required) will add to the large total.

Perhaps for obvious reasons, Israel is the one country that has explicitly accepted not only the existence of the threat but the need to directly address it. Initially driven by the SCUD missiles that were fired against Tel Aviv during the 1987 Persian Gulf War, there is no question that Israel takes very seriously the need to fund, develop and deploy missile defense systems. One-third of the population of Israel is under the threat of tactical ballistic missiles from Iran and other potential adversaries; so, to Israel, those tactical missiles are a strategic threat. Together with the United States, Israel has developed the ARROW

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[1] Lt. General O'Reilly, National Defense University Speech, June 2, 2009.
[2] ISN (Switzerland), "NATO Launches Missile Defense Program," March 17, 2005.
[3] GAO, "BMD: Actions Needed to Improve Planning and Information on Construction and Support Costs for Proposed European Sites," August 6, 2009.

missile defense system (including its ground-based radars)—for defense against the Shahab-3—and has not only successfully tested it (by 2004 it had achieved 6 out of 7 hit-to-kill intercepts of SCUD (or SCUD-like) targets),[4] but had deployed the first operational battery, with the intent to deploy up to three batteries to protect the whole country. They have also integrated the Arrow system with the shorter-range PAC-3 System, which will provide them with a layered defense-in-depth. Then, in 2006, Israel initiated the potential to add another layer to the defense by addressing an airborne system that could go after the launchers and/or the boost phase. Finally, Israel and the United States have jointly developed, and successfully demonstrated, the THEL ground-based laser system to shoot down Katyusha rockets; the two countries have been exploring other variants of this system to gain greater military capability, including mobility.

In 1998, the over-flight of Japan by a North Korean Taepodong-1 spurred the island country to explore defense against ballistic missile attacks. However, because of strong concerns regarding Japanese constitutional issues, Japan initially chose to limit its involvement to joint research and development activities with the United States on a "theater" defense system (built on the U.S. ship-based missile defense system). However, in 2009, as noted above, Japan decided to not only deploy the sea-based SM-3, but also to procure the land-based, high-altitude, U.S. Army THAAD system, and to deploy an X-band radar for target discrimination.

The area that will require the most attention in the coming years is assuring the cooperation of Russia and China (probably in that order) for a new ABM Treaty that will allow the United States and its allies to deploy missile defense systems geared to defend against rogue nations and unintentional launches. However, the United States must be careful to stress that this increased defense would be no threat to either Russia or China, in terms of their strategic deterrent postures. It is essential that they recognize that the U.S. system is not intended for use against them. In fact, it will be necessary to show how it cannot become a threat to them—even with growth and enhancements in the future—through treaty constraints and verification techniques. Perhaps the best approach here is through joint programs (e.g. sharing of missile warning centers, sharing of radar tracking sites, etc.). This will, of course, require changes in U.S. technology export controls (ITAR,

[4] *Aviation Week and Space Technology*, September 23, 2004.

EAR, etc.).[5] The increasing globalization of industry, technology, and particularly security, is increasingly making such changes mandatory, in any case.

[5] Brad Graham, "U.S. Controls Hamper Foreign Role in Missile Defense," *Washington Post*, October 19, 2003.

Chapter 8

Recent Policy Considerations

Ballistic missile defense is rapidly evolving (in technology and in strategic policy). It is still highly controversial; and the debate has intensified since the September 11th terrorist attacks on New York and Washington. In fact, after the attacks—and the declaration of the "war on terrorism"—many were urging a shift of resources from NMD to antiterrorism, suggesting that the latter was a more urgent demand. Others (the author included) argued that <u>both</u> terrorism and ballistic missiles presented likely "asymmetric" threats over the coming years, based on credible rationale (such as that presented at the beginning of this book). It is not an "either/or" choice; rather, both need to be addressed; and, in today's globalized, geopolitical environment, both need to be addressed multi-nationally (as the prior chapter highlighted). Finally, the resources required for the increased efforts against terrorism should come from other sources than missile defense (including from current DOD investments in more "traditional" weapons platforms, such as those intended for 20th-century warfare scenarios).

Clearly, two considerations have been driving the advocacy of NMD in recent years: first, the widespread *proliferation* of long-range missile technology and weapons of mass destruction (nuclear and biological) into the hands of "rogue" actors (states and non-state); and second, the basic *insecurity* that many feel knowing that these weapons exist, that they are growing in number, and that there has been little deployed in defense against them.

Addressing these concerns would, of course, only be addressing a subset of problems concerning America's national security strategy—which recognizes that, in the future, countries will not try to match the U.S. plane-for-plane, ship-for-ship, aircraft-for-aircraft, etc. Instead, adversaries will use so-called "asymmetric" approaches; namely, those which can be effective against the overall military and economic strengths of the United States. Asymmetric threats include terrorism

and the use of biological, chemical, and nuclear weapons; information (cyber) warfare; and long-range ballistic missiles. The fact that many of the leaders of rogue states (and non-states) have stated the objective of killing as many Americans as possible, and that they have no fear of retribution and the death of many of their own supporters, is what gives substance to their threats. (Obviously, both points were clearly demonstrated in the September 11, 2001, suicide attacks on the World Trade Center in New York and the Pentagon in Washington, DC)

Because each type of ballistic missile defense system has both its strengths and its weaknesses, the United States tends to favor a "defense-in-depth" approach (i.e. a layered defense system). Such an approach emphasizes a combination of a ground-based, a ship-based, a potential airborne laser, and even a potential future space-based laser or space-based kinetic kill system; covering the full domain from boost-phase intercepts, through midcourse, to terminal-phase kills. In any case, there is a desire to continue R&D on all of these approaches in order to see which ones will "work, for the time periods in which they could be available"—fully taking into account the relevant technical, economic, and geopolitical issues.

There is recognition that *concentration on non-proliferation becomes an absolutely essential first priority*, as many in America—and elsewhere—witness the widespread proliferation of weapons of mass destruction and their delivery vehicles. However, because of the difficulty of stopping proliferation, a "second best" solution appears to be the development and, when demonstrated to be effective, deployment of a limited defense system—one that would include both the United States and its allies.

Because of the obvious need for a "fresh look" at America's overall strategic posture (offensive and defensive, and their combination), in 2009 a special "Congressional Commission on the Strategic Posture of the United States" was established; with former Department of Defense Secretaries Dr. William Perry and Dr. James Schlesinger as co-chairs. They concluded[1] that missile defense is an "integral part" of U.S. strategic posture. (That same year, U.S. Strategic Command took on the role of "integrating offensive and defense strategic systems in operations.") Specifically, the Commission concluded:

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[1] "America's Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States," U.S. Institute of Peace Press, Washington, D.C., 2009.

- “Missile defenses can play a useful role in support of the basic objectives of deterrence” by “raising doubts in a potential oppressor’s mind about the prospects of success in attempts to coerce or attack others” and by reducing the risks the United States would face in protecting them against a regional aggressor.
- “The Commission strongly supports continued missile defense cooperation with allies.”
- The focus of U.S. ballistic missile defense should be on “protecting against limited strikes” while “taking into account the legitimate concerns of Russia and China about strategic stability.”
- “Current U.S. plans for missile defense should not call into question the viability of Russia’s nuclear deterrent.”
- “The United States should ensure that its actions do not lead Russia or China to take actions that increase the threat to the United States and its allies and friends.”
- The United States and Russia “need to come to an understanding on missile defense, if possible.” To do this, “the United States should explore more fully Russian concerns”; and “the two should define measures that can help build needed confidence.” “This might facilitate and include genuine and mutually-beneficial technical and operational collaboration in this area.

Chapter 9

Dispelling Myths and Misconceptions

Before moving on to a specific set of recommendations for the future, let me briefly summarize the actual "realities" (based on the data above) relative to the many misperceptions that currently exist concerning ballistic missile defense:

There is no threat. Because of the widespread proliferation of ballistic missiles to rogue countries (as described above), and the erratic behavior of their leaders (in many cases appearing, to us, as both irrational and immoral), it should be of great concern to the American people that we have no defensive capability. This makes the United States not only vulnerable to attack, but to threats of attack; and such threats must be considered possible and potentially highly lethal. Additionally, the deteriorating condition of the Soviet control systems for their missiles, which are maintained in a continuously "ready" state (unlike the Chinese, who keep their warheads separate from their missiles), makes the possibility of an inadvertent Russian launch quite realistic.

This ballistic missile defense "stuff" all started with Reagan's SDI. As elaborated in the prior historical review, there has been extensive work and analysis conducted on this problem, in the United States, for more than 50 years. "Star Wars" is not the only system—nor the most likely system—being considered, although the critics continue to insist on using that terminology.

You can't hit a bullet with a bullet. As noted above, five of the first seven flight tests of the U.S. NMD system were successful in hitting and destroying the warhead, in the presence of limited decoys. The other two didn't "miss"; they had reliability problems, which prevented mission completion (so, for those two attempts, we don't know if the missiles would have "hit" their intended target). Given the five direct hits, it is clearly possible to achieve intercept, as subsequent test flights continue to demonstrate. In fact, in the 10 years from 1999 to 2009, the combination of the land-based (PAC-3 and THAAD), the sea-band (SM-3) and silo-based (NMD) anti-ballistic missile "hit-to-kill"

systems achieved a total of 43 successes out of 53 attempts[1]—an 81 percent record. This is a particularly high success rate for any R&D program—especially for one so complex and challenging. (For example, "Discover," an early intelligence satellite program, had 12 failures before it succeeded, and the highly successful Polaris submarine-launched ballistic missile program had many early failures.) The reality is that on R&D programs (perhaps counter-intuitively), we learn more from a failure than a success. And, if there is adequate testing in an R&D program, and if an approach of "fly-find-fix-fly" is followed, the reliability of success continues to grow—and this has been found for the anti-ballistic missile program, since from 2007 to 2009 there were 16 successes out of 18 attempts[2]—an 89 percent success rate.

It is important to emphasize that, while no system is perfect, as General James Cartwright (then head of U.S. Strategic Command, and later Vice Chairman of the Joint Chiefs of Staff) has stated[3] even modestly effective defense (and the data above indicates <u>far</u> <u>more</u> than "moderately effective") against long-range missiles is worth the investment—even compared to competing military priorities—because they might deter a nuclear attack. He went on to state that "To me, you've got to have a credible offense and defense. The offense is not enough to bother them."

Of course, work still remains to be done on ensuring that the interceptor will properly target the warhead (versus sophisticated decoys) through enhanced discrimination techniques—and this capability is the focus of continuing R&D and test efforts. Nonetheless, the ability to "hit a bullet with a bullet" has been clearly demonstrated; and, with the possibility, if needed, of salvo launches, has an extremely high probability of success.

Deployment of a ballistic missile defense system will cause an arms race. This is definitely a potential danger and must be carefully

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[1] MDA Historian's Office, "Hit-to-Kill Interceptor Test Summary (Ballistic Missile Targets Only)," August 5, 2009. Similar data (from 2001 to 2009) of 37 successes of 46 attempts, was presented by Lt. Gen. Trey Obering and Eric Edelman, "Defense for a Real Threat," *Washington Post*, July 6, 2009.

[2] Lt. General O'Reilly, presentation at National Defense University, June 2, 2009.

[3] General James Cartwright, as reported in *Inside the Pentagon*, "Cartwright: Missile Defense-Based Deterrent is Worth the Cost," May 13, 2005.

monitored. However, it is clear that if Russia continues to abide by the current strategic arms limitations, and future agreements include regulations of not only offensive but defensive systems to the satisfaction of both Russia and the United States, then an arms race is not likely (even if Russia could afford it—which it can't). In the case of China, it is clear they are already continuing to build up their strategic forces, and have geared toward a second-strike capability. These efforts will likely continue whether or not there is a National Missile Defense system. Nonetheless, it is important to assure them, and to demonstrate, that the proposed system is not aimed at defending against them. Arms control negotiations must be completed with Russia and China, including verification techniques, and covering both offensive and defensive systems. As for the other countries, the emphasis on non-proliferation is absolutely essential; and this certainly applies to support from Russia and China. In fact, such support is required if an arms race is not to be extended to other countries.

An NMD system is not affordable. The current levels of expenditure on National Missile Defense (NMD) have been in the range of $4 billion per year. Even with some increases (such as those incurred during the Bush Administration), this is still very affordable within National Security expenditures of over $500 billion per year. The question is one of priorities; increasingly, homeland defense is becoming a major priority for the United States and its allies.

The United States is more vulnerable to terrorists or to attacks by nation states using suitcase-based weapons of mass destruction, so why "waste" money on NMD? Clearly, these threats also need to be addressed. However, it is not a question of one or the other. The issue is how to address *both* forms of threats within future budgets. In the nation's 2001 budget, the United States devoted around $12 billion to anti-terrorist actions, and around $4 billion to national missile defense. By 2008 those numbers (as a result of the September 11, 2001 attacks) rose to an anti-terrorism budget of well over $100 billion (depending upon how much of the "war on terrorism" is included, along with the share of the Dept. of Homeland Security and the Intelligence budgets); and the Bush administration drove the total missile defense budget (including theater missile defense systems) to over $12 billion. However, to ignore one realistic threat because of another simply doesn't make sense—the risk is too high, and the insurance is affordable.

Fear of nuclear retaliation will prevent anyone from using ballistic missiles on cities. This certainly was not the case when Saddam Hussein used SCUDs against Tel Aviv, even though he knew that Israel had nuclear weapons. Some postulate that this may have deterred him from using chemical or biological warheads, but it certainly did not deter him from attacking civilian populations. The suicide attacks on the World Trade Center and the Pentagon, and the fact that Saddam was willing to use chemical weapons on his own people in the Iran/Iraq war, has convinced many people that attempting to deter irrational actors by possessing the ability to retaliate against their population is not a sufficient defense (and certainly not a high-confidence one). Nonetheless, this issue does highlight that it is critically important for policy makers in the United States to better understanding the minds, language and culture of future potential adversaries (what has become known—in "DOD talk"—as "human terrain understanding"). The actions of others may appear to us to be "irrational," but their behavior may be very "rational" from their perspective. We need to understand exactly how they perceive our statements and our actions, especially as we plan our security policies, including offensive and defensive control agreements.

We already have systems deployed that can shoot down those missiles. The majority of Americans, amazingly, believe that we already have the deployed capability to handle an ICBM attack. It is important to dispel this myth. The reality is that we do not currently have such a capability fully deployed. However, with the initiation of the Alaska and California sites, the process has begun; and (as of February 2010) with 30 ground-based interceptors in place, the U.S. does not have potential protection against a limited, unsophisticated set of missiles.[4]

[4] "Ballistic Missile Defense Review Report," Department of Defense, February 2010.

Chapter 10

A Proposed Middle Path to Ballistic Missile Defense

In the post-Cold War era, most people in both Russia and the United States believe that a new national security posture is required. In fact, in 2001, Russian President Putin acknowledged the need for a "new architecture of security,"[1] an idea later advocated by both President Bush and, later, President Obama. There is widespread agreement that a new strategic posture needs to be one that is mutually agreed to. This should not simply be because it is in writing, but because it will satisfy each nation's national security needs and is, therefore, self-sustaining. Additionally, there seems to be widespread agreement that there can not simply be a bilateral strategy between the United States and Russia alone. Eventually it will need to include other countries that are affected, from Europe (both the E.U. and individual countries), to China, India, Japan, and others. Finally, there is growing agreement that this new strategic posture should have a balance of both offensive and defensive considerations. Given the issues outlined above, I propose the following 6-point program:

1. The first and primary *emphasis must be on proliferation control*—not just in terms of preliminary negotiations, but in terms of effective controls and implementation by all countries. This must be done on a bilateral, multi-lateral and worldwide basis. . Thus, the focus needs to be not just on treaties and agreements, but on implementation and monitoring.

2. We must *work, proactively, with our allies, as well as Russia and China*, to develop a stable new strategic posture—one that includes both offensive and defensive systems. This cooperation is necessary in order to achieve the stability required for mutual security. In fact, in

[1] *Newsweek*, June 25, 2001.

2009, Russian Foreign Minister Sergei Lavrov stated his insistence that any new nuclear treaty should include agreements on missile defense.[2]

On the defensive side, the United States must work with Russia on replacing the 1972 Anti-Ballistic Missile Treaty with an agreement that allows limited defenses against rogue states, but bars the United States and Russia from developing defenses that threaten the other's nuclear deterrent. The two nations must work together in this area, as "confidence building" steps (and similar steps must be taken also with China). In 2007, Russia and the United States began negotiating the sharing of global missile launch data, in a center to be created outside Moscow. And, that same year, Russian President Putin proposed to President Bush the conversion of the Russian-operated radar in Gabala, Azerbaijan into a joint Russian-American BMD facility.[3] Both of these examples represent important moves at cooperation and stability.

On the offensive side, it is essential that Russia work on enhancing its systems of warning, and command and control; in particular, it must demonstrate a reliable control over any inadvertent missile launch. A major step in this direction would be the reduction of both U.S. and Russian offensive systems from their current "instant-alert" status. (A condition that, fortunately, China has not pursued—so there is far less likelihood of a catastrophic, inadvertent launch.) Additionally, since both Russia and the United States have an extensive overkill capability, in terms of the numbers of strategic warheads that each country has, they should both rapidly move toward an agreement that would dramatically reduce arsenal numbers; however, these efforts must be consistent with both the ability to have a nuclear second strike deterrent and to recognize the presence of each other's missile defense systems. At the end of the Cold War, the United States had 5400 strategic warheads on land and sea; 1750 nuclear bombs and cruise missiles for airborne delivery by B52's and B-2's; 1670 "tactical nuclear weapons"; and approximately 10,000 nuclear weapons in "storage" (to match a potential Russian buildup, in case of a future "breakout" need).[4] In January of 1993, President George H. W. Bush and Russian President Boris Yeltsin each agreed to go down to the range of 2000 to 2,500 by the end of 2007. Since then, both countries have been talking about

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[2] Reuters, May 20, 2009.
[3] Richard Weitz, "A Bush-Putin Decision on the Radar," *Washington Post*, June 20, 2007.
[4] *Newsweek*, June 25, 2001.

going down to levels in the range of 1,000 to 1,500 (including in a summit discussion in 2009, between President Obama and President Medvedev), which is still quite adequate to assure mutual destruction of both societies and their military capabilities (this prediction takes into account that a thermonuclear attack on Washington is estimated to kill between 500,000 and 900,000 people, compared to the World Trade Center loss of approximately 3,000 people).

3. *Research, development and testing must be continued* on options for a limited, national missile defense system that could be deployed within a reasonable time period, and that could be consistent with the new ABM treaty discussed above. The overall design of this system must place an increased emphasis on the multi-national aspects of the system's architecture, with particular consideration given to allies' defense. The system must also stay in accordance with the explicit intent to be limited to its capability against small numbers of unsophisticated launches by rogue states, and possibly an inadvertent launch from Russia. But with growth capability to handle increased decoy sophistication from rogue states (still on a limited-quantity basis—consistent with the above-noted treaties).

It must be emphasized that, because test flights are so very expensive (for the interceptor, the target, the range implementation, etc.) it is essential that a great deal of effort be expended on modeling and simulation of the many possibilities (e.g. geometries, countermeasures, etc.); and that the test flights themselves be seen as not only proofs of the designs, but primarily as validations of the far-less-costly models and simulations.

4. We must also make sure that *deployment planning for the limited, multi-national system is within treaty constraints* that have been mutually agreed to. This will help to ensure that it can't grow to threaten Russia's, or even China's, likely treaty-controlled deterrent force in the future.

5. *The system should be deployed as soon as it is shown to work effectively*. This does not mean it has to be 100 percent effective, but it does mean that it is sufficiently reliable and will be effective against reasonable threat scenarios from rogue states. We must also continue to evolve the capability of this "limited" system in terms of target discrimination, as intelligence inputs indicate an increasing technological sophistication of potential threats. Clearly, the emphasis of this system must be on saving American lives. While this can't be

done perfectly, the decision criterion is that it can be done effectively, in order to warrant the investments and the potential political risks of deployment.

Additionally, a major share of the continuing program effort must be devoted to achieving maximum reliability of the overall system (not just the interceptors, but the command and control system, the sensors, the computers, and the communication system that links it all together). This is a mission for which reliability is crucial, and it must receive continuing attention.

6. Finally, it is crucial to *defer space-based kill systems deployment* because of the potential, perceived threat to Russia and China. However, we must continue to place urgent emphasis on resolving all of the issues associated with items 1 through 5—including, working closely with Russia and China on them. Since any space-based kill system is at least a decade away, a decision on such deployment must wait until we see how much progress can be made in the next few years without it.

Chapter 11

Summary

I mentioned at the beginning that the issue of ballistic missile defense is a highly polarizing one, and people often address it with an almost religious fervor. However, it is clearly time to step back and address the issue in a more thoughtful fashion. If, as most people now acknowledge, there is a growing threat from widespread proliferation of weapons of mass destruction and delivery capabilities for them, then we need to address how this threat can be deterred and/or countered. My personal view is that, in answering the two basic questions ("can it be done?" and "should it be done?"), I believe we will find that *it can be done*, and *we have no alternative to doing it*. But it must be done within an environment that recognizes the need for a mutually-agreeable and stable overall security posture. This posture is one that includes the needs of not only the United States but also of traditional allies in North America, Europe and Asia, as well as countries such as Russia and China. I genuinely believe that this can be done, but we must start now, in order to have it in place in future years. It must be part of America's early 21st century national security posture. Our citizens deserve it, and so do the citizens of the many other countries involved.

About the Author

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Dr. Gansler served as Under Secretary of Defense for Acquisition, Technology and Logistics from November 1997 to January 2001. In this position, he was responsible for all matters relating to Department of Defense acquisition, research and development, logistics, acquisition reform, advanced technology, international programs, the Ballistic Missile Defense Organization, environmental security, nuclear, chemical, and biological programs, and the defense technology and industrial base. (He had an annual budget of over $180 billion and a workforce of over 300,000.)

Dr. Gansler was Executive Vice President and Corporate Director for TASC, Incorporated, an applied information technology company (1977–1997), in which position he played a major role in building the company from a small operation into a large, widely-recognized, and greatly-respected corporation, serving both the government and the private sector. From 1972 to 1977, he was Deputy Assistant Secretary of Defense (Materiel Acquisition), responsible for all defense procurements and the defense industry; and as Assistant Director of Defense Research and Engineering (Electronics) responsible for all defense electronics research and development. Prior to this, he was a Vice President of ITT Avionics; a Program Manager for maneuvering re-entry guidance systems at General Precision; and a designer of anti-aircraft missile guidance systems at Raytheon.